APPLYING ITEM ESSENTIALITY to WHOLESALE LEVELS SETTING

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Report 162

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PROJECT NUMBER N9322-D37-4069

REPORT NO. 162

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DATE: MAR 29 1985

Abstract

This analysis develops a method of using Item Essentiality values in computing wholesale Safety Levels. Item Essentiality values signify the importance of an item to the Navy Supply System. Item Mission Essentiality Codes (IMECs) and equipment Mission Criticality Codes (MCCs) were used to develop Item Essentiality values. This analysis recommends Supply Material Availability (SMA) and Average Days Delay (ADD) standards for each Item Essentiality value within a two digit Cognizance Symbol (Cog). No group of items received less protection than currently approved. The recommended effectiveness standards considered Item Essentiality, cost, requisition frequency and procurement leadtime.

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Executive Summary

1. Background. This study developed a method of using Item Essentiality values to compute wholesale Safety Levels. Item Essentiality values indicate the importance of an item to the Navy Supply System. Item Mission Essentiality Codes (IMECs) and Mission Criticality Codes (MCCs) were used to develop Item Essentiality values. Aviation Supply Office (ASO) items were not included in this study because aviation Item Essentiality coding was not in place at the beginning of the analysis. The current procedure to determine Safety Level emphasizes requisition frequency and item cost. Currently, Item Essentiality has a minor impact on Safety Level determination.

2. Technical Approach. The Computation and Research Evaluation System (CARES) Analyzer, which projects cost and effectiveness figures, was used to compare the current stocking policy to proposed methods. The input for the CARES model included the universe of 1H, 7H and 7G Cognizance Symbol (Cog) active items. The intent of this analysis was to develop a method which maintains the current performance for the least essential items while improving effectiveness for higher essential items. This could not be accomplished without increasing inventory costs. A total budget initiative of $265 million (M) was approved for increased levels due to IMECs for the three year period following implementation; $100M was approved for the first year. A set of CARES results were produced concentrating on Supply Material Availability (SMA) goals by Item Essentiality and another set of CARES results were produced emphasizing Average Days Delay (ADD) targets by Item Essentiality. The current overall goals for SMA and ADD are 85% and 26 days.

3. Findings. SMA and ADD goals were achieved for 1H items by Item Essentiality without significant increases to inventory costs. However, while SMA goals were reached for repairable items adhering to the budget initiative, the

corresponding ADD figures were twice as high as the goal. To achieve the ADD goals for repairable items, the inventory costs increased nearly $500M.

4. Conclusions. SMA and ADD goals do not compliment each other for repairable items due to higher item costs, lower requisition frequencies and longer procurement leadtimes when compared to consumable items. Therefore, SMA and ADD standards were set by Item Essentiality and two digit Cog considering the item characteristics mentioned above. The final recommendation of this analysis increased total costs by $286M, of which $119M is required in the first year. The total cost is $21M or 8% greater than the current budget initiative established for IMECs. Approximately $19M of the $21M increase is required in the first year. Assigning the highest IMEC may cause items to migrate to higher essential categories as voids in MCC coding are filled, and hence, increase inventory costs identified in this study. Implementing an average IMEC after Resystemization, as previously recommended by Navy Fleet Material Support Office (FMSO), would lessen the probability of migration occurring.

5. Recommendation. FMSO recommends assigning a constant maximum risk by Item Essentiality regardless of Cog as shown in TABLE I.

TABLE I

Maximum Risk Constraints

Item Essentiality	Maximum Risk
1	.50
2	.50
3	.40
4	.35

For each Cog and Item Essentiality grouping, shortage costs should be selected to achieve the effectiveness goals displayed below.

TABLE II

Effectiveness Goals

Cog	Item Essentiality	ADD	$MA
1H	1	34	86
1H	2	26	90
1H	3	22	91
1H	4	17	92
7H/7G	1	64	85
7H/7G	2	52	88
7H/7G	3	47	90
7H/7G	4	42	91

I. INTRODUCTION

Reference (1) established a study to develop a method of using Item Essentiality values to compute wholesale Safety Levels such that no category of items receives less protection than currently approved. (APPENDIX A lists all references for this report.) Item Essentiality signifies the importance of an item to the Navy Supply System. This study included only Navy Ships Parts Control Center (SPCC) items because Item Essentiality values were unavailable for Navy Aviation Supply Office (ASO) items at the beginning of this analysis. We plan to conduct a similar analysis using aviation data in the near future. A single Item Essentiality value was assigned to every item based on Item Mission Essentiality Codes (IMECs). IMECs were developed from equipment Mission Criticality Codes (MCCs) which were created from Casualty Reporting System (CASREP) data. Details concerning the methodology to produce Item Essentiality values are provided in references (2) and (3). The definitions for each Item Essentiality value are listed in TABLE I.

TABLE I

Item Essentiality Definitions

Item Essentiality Value	Definition
4	lack of item causes total loss of primary mission capability
3	lack of item results in severe degradation of primary mission capability
2	lack of item results in loss of secondary mission capability
1	lack of item causes minor mission impact

Values of 5 identify items related to life support and personnel safety equipment, but in this analysis these items were coded as 4s. This does not bias the results because both categories of items receive maximum Safety Level protection.

The main factor to compute Safety Level in Uniform Inventory Control Program (UICP) is the acceptable risk of stockout (risk) equation. Risk influences Safety Level such that higher risk reduces Safety Level and lower risk generates more Safety Level. The UICP wholesale risk equation includes an essentiality parameter as shown below:

$$\rho = \frac{SIC^*}{SIC^* + \lambda E}$$

where

ρ = acceptable risk of stockout

S = average quarterly requisition size forecast

I = holding cost (.23 for consumables and .21 for repairables)

C^* = average acquisition price = $(1-B/D)\ C + (B/D)\ c'$

B = quarterly regenerations forecast

D = quarterly demand forecast

C = replacement price

c' = repair price

λ = shortage cost

E = item essentiality (constant .5 at SPCC)

Since SPCC currently assigns a constant value for E, the risk equation does not differentiate in Item Essentiality through the use of E. Instead, SPCC considers essentiality by adjusting λ and maximum risk constraint. The selection of λ and maximum risk are based on two digit Cognizance Symbol (Cog) segmented by four categories of items and three groups of requisition frequencies. The four categories of items are Weapon System Support (WSS)/ TRIDENT, non-WSS, Nuclear and Fleet Ballistic Missile (FBM) related material. Non-WSS items receive lower λ values and higher maximum risk constraints to provide less Safety Level than the other categories of items. Items with higher requisition frequency are assigned higher λ values and lower maximum risk constraints to generate better protection than for items with low requisition frequency. Finally, Item Essentiality is considered only for items with low requisition frequency and the lowest Item Essentiality value of 1. These items are assigned a higher maximum risk constraint and sometimes a lower λ value than other items in the same category and requisition frequency. The current procedure to determine Safety Level is cumbersome and requires a considerable amount of manual intervention to set λ values.

II. TECHNICAL APPROACH

A. PROPOSED METHODS. The objective of this study was to develop a method to compute wholesale Safety Level based on Item Essentiality. Several of the methods originally outlined in the study description of reference (1) were not evaluated in this analysis because of direction received during reference (4) to recommend a method which did not entail program modifications to UICP. The methods analyzed in this study are described below:

1. Risk (ρ) - Select a constant risk for the various Item Essentiality values.

Example:

Item Essentiality	ρ
1	.25
2	.20
3	.10
4	.05

This method disregards any consideration for the cost of an item when determining Safety Level. An item with a given essentiality receives the same Safety Level protection whether the item costs $1.00 or $50,000.

2. Shortage Cost (λ) - Select a constant λE value for the various Item Essentiality values. Set the minimum and maximum risk constraints to .01 and .99, respectively.

Example:

Item Essentiality	λE
1	500
2	1,000
3	1,500
4	2,000

This method allows the cost of the item to influence Safety Level. That is, a high cost item with an essentiality of 4 can have a considerably higher acceptable risk of stockout than a low cost item with an essentiality of 1.

3. Shortage Cost/Maximum Risk ($\lambda\rho$) - Select a constant λE value and maximum risk constraint for the various Item Essentiality values. The minimum risk constraint remains at .01 for all items.

Example:

Item Essentiality	λE	Maximum ρ
1	500	.25
2	1,000	.20
3	1,500	.10
4	2,000	.05

This method combines the logic of the previous two by selecting E values and maximum risk constraints by Item Essentiality. Safety Level is determined primarily by Item Essentiality, but the cost of the item is also considered.

The parameter values specified in the examples serve to illustrate the methods and are not necessarily those used in this analysis. The values do show how the more essential items are provided with better Safety Level protection. The parameter values were adjusted for each two digit Cog, particularly between consumables and repairables, due to the differences in characteristics of the items. In the methods described, the shortage cost and essentiality were combined (λE) and treated as one value as in reference (5). By definition, essentiality should be included in shortage cost.

B. PROCESSING METHODOLOGY. The Computation and Research Evaluation System (CARES) analyzer described in reference (6), was used to compare the proposed methods to the current inventory policy. The CARES analyzer projects cost and effectiveness figures for various parameter settings. The particular versions of CARES used in this analysis were the Conventional Consumable Model and the Integrated Repair Model without augmenting Reorder Level by the Economic Repair Quantity. All currently approved inventory policies, such as employing annual buy quantities, were followed when processing CARES. Since the parameters in CARES were set consistent with SPCC policy, the capability to adjust the performance indices by the expected Nonrecurring Demand (NRD) was not used. Thus, for the investment shown by CARES, the effectiveness values are overstated. That is, the SMA results are higher and ADD figures are lower than the actual effectiveness values experienced by the Navy Supply System. The final recommended effectiveness goals were adjusted to compensate for NRD and reflect real-world values.

The three proposed methods were processed through CARES in a preliminary analysis using a sample of input items. The current stocking policy with the latest parameter settings (referred to as Execution) was also processed through CARES on the same sample of input items. Several sets of parameter values were tested for the three proposed policies to obtain a wide range of cost and effectiveness values to compare with the Execution results. The findings of this preliminary analysis were presented during reference (7). One of the proposed methods was selected along with the Execution policy to process through the CARES analyzer again using the universe of input items as opposed to a sample. This comparison allowed for a more precise quantification of the cost and effectiveness measures to the supply system.

C. INPUT. The CARES input for this study included active 1H, 7H and 7G Cog items from the September 1984 timeframe. (In general, an item is considered active if any of the current demand, repair or leadtime observations are greater than zero. APPENDIX B contains detailed active item criteria.) Since Nuclear and FBM material were not assigned Item Essentiality values at the beginning of this study, these items were not included in this analysis. Although TRIDENT items were included, additional Protection Levels will continue to be provided to these items to support approved higher effectiveness goals. The number of items and Item Essentiality distribution for the universe of items are shown in TABLE II. The values are segmented by three digit Cog; that is, the usual two digit Cog and the Item Essentiality as the third digit. The statistics are summarized by two digit Cog, repairables, all items and also displayed by Item Essentiality combining all Cogs at the bottom of the table.

TABLE II

Input Items and Item Essentiality Distribution

Cog	Items	% of Cog	% of Univ.
1H1	37,335	47	33
1H2	8,445	11	7
1H3	24,234	30	21
1H4	9,587	12	9
1H	79,601	100	70
7H1	9,130	37	8
7H2	2,840	12	2
7H3	8,658	35	7
7H4	4,040	16	4
7H	24,668	100	21
7G1	6,129	60	5
7G2	1,239	12	1
7G3	2,399	24	2
7G4	425	4	1
7G	10,192	100	9
7H/7G	34,860	100	30
1H/7H/7G	114,461	100	100
1s	52,594	-	46
2s	12,524	-	11
3s	35,291	-	31
4s	14,052	-	12

The highest IMEC value for an item was chosen as the Item Essentiality value. If the item had only partial IMEC information, the highest IMEC was still chosen as the Item Essentiality value. If the item had no IMEC information, the item was assigned a 0 as an Item Essentiality value. During Levels Setting, SPCC treats 0s as 1s. Therefore, 0s were recoded as 1s for this analysis and are included in TABLE II. Ten percent of the CARES input, or

11,402 items, were recoded from 0 to 1. This factor increased the items with essentiality values of 1 to 46% of the universe which is much greater than the distribution of reference (2). These items without any IMEC information are primarily related to shore base activities but also include ships parts not yet coded. Since Item Essentiality values are developed from CASREP data, there is presently no method to code shore base items.

D. MEASURE OF EVALUATION. The following outputs provided by the CARES analyzer were used to compare the various stocking policies: Supply Material Availability (SMA), Average Days Delay (ADD), dollar value of Safety Level ($SL) and dollar value of First Year Buys ($FYB). SMA is calculated as the requisitions satisfied "off the shelf" divided by the total number of requisitions submitted. ADD is measured from the submission of a requisition until the first receipt of material by the requestor. Safety Level is defined as the difference between Reorder Level and leadtime demand. The major difference between the proposed methods and the current stocking policy is the calculation of Safety Level. Therefore, the difference in $SL represents the difference in total costs among the various stocking policies throughout the transition period. $FYB represents the cost incurred during the first year because $FYB considers assets already in the system. Items recently procured whose assets exceed the new Reorder Level do not require a procurement during the first year and do not increase $FYB. However, items which require a procurement increase $FYB by the increase in $SL plus an Order Quantity and the deficiency to the original Reorder Level, if any. When considering $FYB, the first case mentioned above was believed to be more prevalent due to implementation of yearly buys. Therefore, increases in $FYB were expected to be less than increases in $SL.

E. EFFECTIVENESS GOALS.

1. SMA and Budget Goals. When processing the proposed method selected from the preliminary analysis through the CARES analyzer, there were no approved SMA or ADD goals. The goals in TABLE III were set as initial goals for this study and were agreed to during reference (7).

TABLE III

Initial Goals

Item Essentiality	SMA
1	85
2	85
3	90
4	95

(An overall ADD of 26 Days)

The current overall SMA goal according to reference (8) is 85%. The intent of this study was to recommend a method which achieves at least the current protection for each category of items. Therefore, the goal for 1s and 2s remained at 85% and the goal for 3s and 4s increased. Once the parameters were set to reach the SMA goals, the parameters were further adjusted to try to attain an overall ADD of 26 days which is the current goal as derived from reference (9). APPENDIX C contains details concerning the derivation of the ADD goal. This was accomplished by improving the performance for Cogs with the highest requisition frequencies and the lowest costs. Similar procedures are followed today to improve overall performance statistics because requisition frequency is a major factor in computing SMA and ADD. A budget constraint of $100M increase in $SL was set by NAVSUPSYSCOM for the initial runs.

Requisition frequency and average item cost distributions are displayed in TABLEs IV and V. Since 1H Cog consumable items draw 71% of all requisitions and are also the least expensive items, more protection was provided for these items than shown by the initial goals. The lowest repair costs of 7 Cog items were greater than the highest procurement costs of 1H items. This reinforces the logic to provide better protection to 1H items. The bottom section of TABLE V shows the cost of items increase as essentiality increases, with the exception of 1s. A price distribution in reference (2) showed for all seven different two digit Cogs analyzed that the 1s were the least expensive items in that Cog. TABLE V may differ due to including 11,420 uncoded items as 1s. Both TABLE V and the distribution in reference (2) conclude that 4s are more expensive than any other essentiality category. Therefore, providing the best protection for 4s will increase inventory costs.

TABLE IV

Requisition Frequency Distribution

Cog	Reqns.	% of Cog	% of Univ.
1H1	122,256	32	23
1H2	61,549	16	11
1H3	108,639	29	20
1H4	88,426	23	17
1H	380,870	100	71
7H1	18,825	18	4
7H2	12,350	12	2
7H3	43,538	42	8
7H4	28,933	28	5
7H	103,646	100	19
7G1	13,036	26	2
7G2	9,300	18	2
7G3	25,286	49	5
7G4	3,715	7	1
7G	51,337	100	10
7H/7G	154,983	100	29
1H/7H/7G	535,853	100	100
1s	154,117	N/A	29
2s	83,199	N/A	15
3s	177,463	N/A	33
4s	121,074	N/A	23

TABLE V

Replacement/Repair Price Distribution

Cog	Average Replacement Price	Average Repair Price
1H1	970	N/A
1H2	878	N/A
1H3	838	N/A
1H4	1,165	N/A
1H	944	N/A
7H1	8,293	2,603
7H2	4,379	1,583
7H3	5,263	1,816
7H4	6,618	2,236
7H	6,494	2,146
7G1	4,662	1,263
7G2	4,393	1,185
7G3	5,608	1,491
7G4	4,862	1,623
7G	4,864	1,322
7H/7G	6,024	1,899
1H/7H/7G	2,468	N/A
1s	2,671	2,064
2s	2,019	1,462
3s	2,247	1,745
4s	2,844	2,177

2. ADD Targets. The ICPs attempt to achieve the overall ADD goal of 26 days by improving the results for 1H items. However, the ADD for repairables has been well above the goal. This may be due to longer Procurement Leadtimes for repairables as illustrated in TABLE VI. Similar to the cost distribution, the leadtimes for high essential items are greater than

the leadtimes for low essential items. Also, the leadtimes for the lowest essential repairables are greater than the leadtimes for the highest essential consumables.

TABLE VI

Leadtime Distribution

Cog	Leadtime
1H1	4.9
1H2	4.9
1H3	5.1
1H4	5.3
1H	5.0
7H1	5.7
7H2	5.8
7H3	6.3
7H4	6.3
7H	6.0
7G1	5.4
7G2	5.7
7G3	5.6
7G4	6.8
7H	5.5
7H/7G	5.8
1H/7H/7G	5.2
1s	5.1
2s	5.2
3s	5.4
4s	5.6

The first set of CARES results displayed in the Findings were reached by attempting to achieve specific SMA values while considering a budget constraint. A second set of CARES results was produced to achieve ADD targets shown in TABLE VII regardless of the costs involved. These targets were set for each two digit Cog. APPENDIX C contains details concerning the derivation of these target values.

TABLE VII

ADD Targets

Item Essentiality	ADD
1	33
2	28
3	23
4	22

F. BUDGET INITIATIVE. A $265M budget initiative has been approved for the three year period following implementation of IMECs. Of the $265M, $100M was approved for the first year. Therefore, the goal of this study was to achieve the best effectiveness possible using Item Essentiality and considering an increase in $FYB of $100M and an increase in $SL of $265M.

III. FINDINGS

A. PRELIMINARY ANALYSIS. During the preliminary analysis, the three proposed methods were processed through the CARES analyzer on samples of input items. This procedure lead to the elimination of two proposed methods to allow a more thorough comparison between the remaining proposed method and the current stocking policy. Specific CARES results from the preliminary analysis are not displayed in this document in order to emphasize the more pertinent results. However, the selection process is described.

The method assigning a constant risk by Item Essentiality was eliminated from further analysis due to the extremely high cost incurred by this policy. Assigning a constant risk overlooks the economics of inventory management. Comparing the CARES results between this method and the current stocking policy showed that $SL doubled for repairable items and increased by as much as 10 times for high essentiality consumable items to achieve the same effectiveness. Considering items of equal essentiality, the current stocking policy "beefs up" effectiveness for less expensive items while sacrificing some effectiveness for more expensive items. Overall effectiveness is reached at economic inventory costs. Assigning a constant risk does not allow improved effectiveness for less expensive items and increases inventory costs by providing equal protection for more expensive items of the same essentiality.

The method assigning shortage cost by Item Essentiality but allowing risk to run free (reach .99) was eliminated due to unacceptable protection for high cost, high essentiality items. Although the CARES results showed this method could provide similar overall effectiveness at lower inventory costs, the objective to provide better protection for items with higher essentiality was not satisfied.

The method of varying shortage cost and maximum risk by Item Essentiality was accepted during reference (7) as the most logical policy to compare to the current stocking procedure. This method considers both economics and Item Essentiality in determining Safety Level. The maximum risk assignments for this proposed method when processed on the universe of items through the CARES analyzer were set at .50, .50, .40 and .35 for 1s, 2s, 3s and 4s, respectively.

B. CARES RESULTS FROM UNIVERSE INPUT.

1. Execution. The cost and effectiveness results from the CARES analyzer for the current parameter settings of the current stocking policy (identified as Execution) are shown in TABLE VIII. As previously stated, the 1H Cog results show much better effectiveness than the results for repairables because 1H items are less expensive, receive more requisitions and have shorter procurement leadtimes than repairables. The overall results by Item Essentiality for all Cogs combined, displayed at the bottom of the table, show that 2s are protected better than 3s and 4s. This occurs because the current stocking policy does not consider Item Essentiality and places too much emphasis on economics.

TABLE VIII

CARES Results
Execution

	Execution			
Cog	ADD	SMA	$SL(M)	$FY Buys(M)
1H1	21	94	60.4	200.7
1H2	13	95	30.9	100.4
1H3	16	94	69.8	146.5
1H4	13	95	56.3	93.2
1H	94	94	217.4	540.8
7H1	100	75	80.5	249.3
7H2	69	85	33.3	63.4
7H3	77	84	122.7	137.8
7H4	70	84	88.7	168.7
7H	78	82	325.2	619.2
7G1	90	76	19.7	78.6
7G2	55	88	14.0	17.9
7G3	53	87	42.4	50.6
7G4	64	86	10.4	13.7
7G	64	84	86.5	160.8
7H/7G	73	83	411.7	780.0
1H/7H/7G	33	91	629.1	1,320.8
1s	36	90	160.6	528.6
2s	26	93	78.2	181.7
3s	36	91	234.9	334.9
4s	28	92	155.4	275.6

2. Proposed Policy - SMA and Budget Goals. TABLE IX shows the CARES results of the proposed policy to achieve the initial SMA and budget goals; i.e., to achieve at least 85% SMA for Essentiality 1s and 2s, 90% for 3s, 95% for 4s, and an overall ADD of 26 days within a budget constraint of $100M increase in $SL. The differences (Δ) from the Execution to the proposed

policy results are also displayed in the table. That is, the Execution results were subtracted from the proposed policy results to illustrate the impact the proposed policy has on the various criteria.

Again, the 1H items have better effectiveness results than repairable items due to item cost, requisition frequency and procurement leadtime characteristics. Although the overall SMA result (88%) for 7H and 7G Cog items is greater than the current goal of 85%, the ADD (58 days) is more than twice the overall goal of 26 days. However, the 16 day ADD for 1H items is low enough to bring the overall ADD to 28 days. The overall results for 2s, as seen at the bottom of the table, show the same SMA (92%) and better ADD (by six days) than the overall results for 3s. The results for 2s were upgraded because these are the lowest cost items and there are fewer 2s (2s comprise 11% of the universe) than any other essentiality. The proposed method improved SMA and ADD for 3s and 4s when compared to the Execution results.

As previously stated, the purpose of this study was to improve effectiveness for high essential items but not decrease currently approved effectiveness standards for any category of items. This cannot be achieved without an increase to inventory costs. As shown in TABLE IX, the results of the proposed policy were achieved by increasing $SL by $100M. The $FYB increased by just half this amount due to the consideration of assets already in the system.

TABLE IX

CARES Results
Proposed Policy - SMA and Budget Goals

	Proposed Policy				Δ Execution to Proposed			
Cog	ADD	SMA	$SL(M)	$FYB(M)	ADD	SMA	$SL(M)	$FYB(M)
1H1	21	92	49.3	198.9	0	- 2	-11.1	- 1.8
1H2	14	94	22.9	96.2	1	- 1	- 8.0	- 4.2
1H3	16	94	69.6	146.0	0	0	- .2	- .5
1H4	11	95	64.2	96.7	- 2	0	7.9	3.5
1H	16	93	206.0	537.8	- 1	- 1	-11.4	- 3.0
7H1	70	84	98.3	256.6	-30	9	17.8	7.3
7H2	70	85	25.4	63.7	1	0	- 7.9	.3
7H3	66	87	144.9	148.9	-11	3	22.2	11.1
7H4	31	93	142.1	193.2	-39	9	53.4	24.5
7H	57	88	410.7	662.4	-21	6	85.5	43.2
7G1	85	83	28.6	83.9	- 5	7	8.9	5.3
7G2	59	85	10.7	17.1	4	- 3	- 3.3	- .8
7G3	50	88	49.7	52.0	- 3	1	7.3	1.4
7G4	24	95	23.4	20.8	-40	9	13.0	7.1
7G	59	87	112.4	173.8	- 5	3	25.9	13.0
7H/7G	58	88	523.1	836.2	-15	5	111.4	56.2
1H/7H/7G	28	92	729.1	1,374.0	- 5	1	100.0	53.2
1s	32	90	176.2	539.4	- 4	0	15.6	10.8
2s	27	92	59.0	177.0	1	- 1	-19.2	- 4.7
3s	33	92	264.2	346.9	- 3	1	29.3	12.0
4s	17	95	229.7	310.7	-11	3	74.3	35.1

3. Proposed Policy - ADD Targets. TABLE X shows the CARES results of the proposed policy to achieve the specified ADD targets by Item Essentiality regardless of inventory costs. As previously stated, these ADD targets and results were primarily developed to show the cost associated with achieving current ADD goals for repairables. The effectiveness results for 1H Cog consumable items are lower in this table when compared to the Execution and

previous proposed policy results. The previous results were improved due to 1H items' lower cost, higher requisition frequency and shorter leadtimes when compared to repairable items. To achieve the ADD targets for repairables, an overall SMA of 95% must be met. This is an increase of 12 percentage points compared to current Execution results. To reach the ADD targets, $SL increases nearly $500M and $FYB increases $191M.

TABLE X

CARES Results
Proposed Policy - ADD Targets

	ADD Target				Δ Execution to Proposed			
Cog	ADD	SMA	$SL(M)	$FYB(M)	ADD	SMA	$SL(M)	$FYB(M)
1H1	33	86	35.6	192.7	12	- 8	-24.8	- 8.0
1H2	28	88	12.2	91.8	15	- 7	-18.7	- 8.6
1H3	23	91	58.3	141.8	7	- 3	-11.5	- 4.7
1H4	22	89	48.5	87.0	9	- 6	- 7.8	- 6.2
1H	27	88	154.6	513.3	10	- 6	-62.8	-27.5
7H1	33	93	164.2	283.5	-67	18	83.7	34.2
7H2	28	94	57.5	73.9	-41	9	24.2	10.5
7H3	23	96	289.8	198.5	-54	12	167.1	60.7
7H4	22	95	165.0	202.1	-48	11	76.3	33.4
7H	25	95	676.5	758.0	-53	13	351.3	138.8
7G1	33	94	67.7	99.9	-57	18	48.0	21.3
7G2	28	95	38.6	19.7	-27	7	24.6	1.8
7G3	23	95	102.3	71.9	-30	8	59.9	21.3
7G4	22	96	24.2	21.2	-42	10	13.8	7.5
7G	26	95	232.8	212.7	-38	11	146.3	51.9
7H/7G	25	95	909.3	970.7	-48	12	497.6	190.7
1H/7H/7G	26	90	1,063.9	1,484.0	- 7	- 1	434.8	163.2
1s	33	88	267.5	576.1	- 3	- 2	106.9	47.5
2s	28	90	108.3	185.4	2	- 3	30.1	3.7
3s	23	93	450.4	412.2	-13	2	215.5	77.3
4s	22	91	237.7	310.3	- 6	- 1	82.3	34.7

4. <u>Proposed Policy - Recommendation</u>. The CARES results of the proposed policy in TABLE IX primarily emphasized SMA goals, and the results in TABLE X were based on ADD targets. TABLE XI displays the CARES recommended cost and effectiveness statistics for the recommended policy. These recommendations were reached considering all of the criteria mentioned to this point. The recommendation for 1H items is very similar to the results shown in TABLE IX with the exception that cost and effectiveness were slightly increased for items with essentiality of 3. Thus, the higher essential 1H items are provided with better protection. For repairable items, the ADD figures in TABLE IX which correspond to the initial SMA goals were too high, and the cost results from TABLE X which are associated with the ADD target values were too high when considering the budget initiatives previously defined. Therefore, additional in-depth analysis was performed to determine realistic effectiveness standards at reasonable inventory costs for repairable items. Various parameters were processed through the proposed method to obtain a wide range of cost and effectiveness figures for each three digit Cog. Graphs were drawn plotting cost versus effectiveness curves. The recommended goals were derived by analyzing the graphs and choosing a point before the flat part of the curve was reached. That is, the $SL was increased until the improvement in effectiveness became negligible. These graphs are provided in APPENDIX D.

TABLE XI shows a significant improvement in effectiveness figures for each Item Essentiality category for 7H and 7G items. The overall effectiveness results for 7H and 7G items show a decrease in ADD from 73 to 39 days and an increase in SMA from 83% to 92%. The results by overall Item Essentiality show improved ADD even for the lower essentiality categories of 1s and 2s due to the significant improvement for repairable items. ADD decreases for 3s and 4s by over 40%.

This policy increases \$SL by \$286M and \$FYB by \$119M. The total \$SL is \$21M or 8% greater than the currently approved budget initative. Approximately \$19M of the \$21M increase is required in the first year.

Based on previous SPCC comparisons between CARES effectiveness projections and the observed effectiveness a leadtime later, the actual SMA will be three to six percentage points lower than shown in TABLE XI. The recommended SMA goals (shown later in TABLE XIII) are adjusted to indicate expected real-world SMA. The recommended ADD goals were adjusted in a similar manner.

The shortage costs required to achieve these goals are provided in APPENDIX E as a guideline for SPCC to follow upon implementation of this policy.

TABLE XI

CARES Results
Proposed Policy - Recommendation

	Recommendation				Δ Execution to Recommendation			
Cog	ADD	SMA	$SL(M)	$FYB(M)	ADD	SMA	$SL(M)	$FYB(M)
1H1	21	92	49.3	198.9	0	- 2	-11.1	- 1.8
1H2	14	94	22.9	96.2	1	- 1	- 8.0	- 4.2
1H3	13	95	86.0	154.1	- 3	1	16.2	7.6
1H4	11	95	64.2	96.7	- 2	0	7.9	3.5
1H	15	94	222.4	545.9	- 2	0	5.0	5.1
7H1	51	88	125.2	268.7	-49	13	44.7	19.4
7H2	43	91	45.7	70.2	-26	6	12.4	6.8
7H3	35	93	211.6	167.6	-42	9	88.9	29.8
7H4	31	93	142.1	193.2	-39	9	53.4	24.5
7H	38	92	524.6	699.7	-40	10	199.4	80.5
7G1	57	89	49.3	92.7	-33	13	29.6	14.1
7G2	41	91	18.2	18.3	-14	3	4.2	.4
7G3	33	92	77.4	61.9	-20	5	35.0	11.3
7G4	24	95	23.4	20.8	-40	9	13.0	7.1
7G	40	91	168.3	193.7	-24	7	81.8	32.9
7H/7G	39	92	692.9	893.4	-34	9	281.2	113.4
1H/7H/7G	22	93	915.3	1,439.3	-11	2	286.2	118.5
1s	28	91	223.8	560.3	- 8	1	63.2	31.7
2s	21	93	86.8	184.7	- 5	0	8.6	3.0
3s	21	94	375.0	383.6	-15	3	140.1	48.7
4s	16	95	229.7	310.7	-12	3	74.3	35.1

IV. SUMMARY AND CONCLUSIONS

The objective of this analysis was to determine how to use Item Essentiality values in Levels Setting for SPCC items. ASO items and SPCC FBM and Nuclear items were not included in this study because Item Essentiality values were not fully developed at the beginning of this analysis. Although

TRIDENT items were included, additional Protection Levels will continue to be provided to these items to support approved higher effectiveness goals.

NAVSUPSYSCOM guidance received during reference (4) desired a recommendation which did not entail program modifications to UICP. The manual intervention to set shortage costs by four digit Cog currently performed at SPCC will continue to be required for the proposed policy. However, the proposed policy will be much easier to manage due to the reduction of the number of Cogs and through improved awareness of effectiveness goals.

Current SMA and ADD goals do not compliment each other. To achieve the ADD goal of 26 days for repairables requires an SMA of 95%. The goal of 85% SMA for repairables generates an ADD of nearly 70 days. This analysis set SMA and ADD standards for each Item Essentiality value within a two digit Cog. The effectiveness standards recommended in this analysis consider the following item characteristics: essentiality, cost, requisition frequency and procurement leadtime.

To achieve these goals requires an investment increase of $286M. The budget initiative for Item Essentiality over the next three years is $265M. Therefore, an additional $21M or 8% increase is required. Since higher essentiality categories are provided with more protection, migration of items to higher essentiality categories would increase inventory costs identified in this study. Assigning the highest IMEC may cause items to migrate to higher essentiality categories as voids in MCC coding are filled. Implementing an average IMEC to determine Item Essentiality values after Resystemization, as recommended in reference (2), would lessen the probability of migration occurring.

V. RECOMMENDATION

The Navy Fleet Material Support Office (FMSO) recommends assigning a constant maximum risk by Item Essentiality regardless of Cog as shown in TABLE XII.

TABLE XII

Maximum Risk Constraints

Item Essentiality	Maximum Risk
1	.50
2	.50
3	.40
4	.35

In addition, we recommend selecting shortage costs by Cog and Item Essentiality to achieve the real-world effectiveness goals displayed in TABLE XIII.

TABLE XIII

Effectiveness Goals

Cog	Item Essentiality	ADD	SMA
1H	1	34	86
1H	2	26	90
1H	3	22	91
1H	4	17	92
7H/7G	1	64	85
7H/7G	2	52	88
7H/7G	3	47	90
7H/7G	4	42	91

APPENDIX A: REFERENCES

1. FMSO ltr 9322-D37/JLZ/143 5250 of 6 Jul 1984.

2. Operations Analysis Report 154A.

3. Operations Analysis Report 143.

4. PHONCON between NAVSUPSYSCOM (SUP 04A) CDR K. Lippert and FMSO (Code 932) Mr. J. Engelman on 9 Aug 1984.

5. Operations Analysis Report 157.

6. CARES III SSDS - Application/Operation D56 of 5 Sep 1984.

7. Meeting among representatives from NAVSUPSYSCOM (SUP 04A), SPCC (Code 0412) and FMSO (Code 932) on 2 Oct 1984.

8. NAVSUPINST 5220.15A.

9. OPNAVINST 4441.12B.

APPENDIX B: ACTIVE ITEM CRITERIA

An item is designated as "active" if any one of the following criteria is met.

1. Any of the following Data Element Numbers (DENs) are > 0.

A004A	System Recurring Demand Frequency Observation
A005	Current System Recurring Maintenance Demand Observation
A005A	Current System Recurring Overhaul Demand Observation
A005B	Current System Carcass Return Observation
A005C	Current System Other Service Demand Observation
A006	Current System Nonrecurring Demand Observation

2. Any Issue Observation (A006C Current System Issue Observation) purpose code other than A or W >0.

3. Item is MARK 2, 3, or 4 (B067B, C, D).

4. Numeric DRIPR Code for any one of DENs B001A, B, C, D, or E.

5. System Order Quantity (B021) = 0.

6. Any of the leadtime observations > 0.

B010G	Cumulative Production Leadtime Observation
B011G	Cumulative Procurement Leadtime Observation

7. Any of the Repairable DENs > 0.

F009D	Cumulative Repair Induction Quantity
B012G	Cumulative Navy Reporting Repair in Process Time Observation
B012K	Cumulative Navy Nonreporting and Commercial Repair TAT Observation

8. Item is in a family (C001A ≠ Blank).

9. System Internal Due-In, Purpose Code A and Condition Code A (A008B) > 0

10. Item has Maintenance Demand Observation History code (B052) other than space.

APPENDIX C: ADD COMPUTATIONS

Reference (9) established the following ADD goals:

System NIS ADD Goals

Location	IPG I	IPG II	IPG III
CONUS	82	87	120
EXCONUS	87	91	150

where

NIS = Not-In-Stock

IPG = Issue Priority Group

CONUS = Continental United States

EXCONUS = Excluding Continental United States

Item Essentiality values were substituted for Locations and IPGs as shown below to express NIS ADD goals by Item Essentiality.

Item Essentiality Substitution

Item Essentiality Value	Location and IPG
1	EXCONUS IPG III
2	CONUS IPG III
3	CONUS IPG II
4	CONUS IPG I

The equation shown below was used to compute the ADD targets displayed in TABLE VII of this document.

$$ADD_i = SMA(IS\ ADD) + (1-SMA)\ (NIS\ ADD_i)$$

where

i = index representing Item Essentiality values 1 through 4

SMA = Supply Material Availability (85% as specified in reference (8))

IS ADD = In-Stock delay time (12 days as specified in reference (9))

NIS ADD_i =

Item Essentiality Value	NIS ADD_i
1	150
2	120
3	87
4	82

The computations and results of the equation to determine ADD by Item Essentiality are displayed below.

Item Essentiality	Computation	ADD
1	(.85)(12) + (.15)(150)	33
2	(.85)(12) + (.15)(120)	28
3	(.85)(12) + (.15)(87)	23
4	(.85)(12) + (.15)(82)	22

Once the ADD targets were obtained by Item Essentiality, the following formula was used to determine the overall ADD.

$$ADD = \sum_{i=1}^{4} ADD_i \; p_i$$

where

i = index representing Item Essentiality values 1 through 4

p = the percent of system requisitions comprised by the specified Item Essentiality category

The figures below were taken from TABLE IV of this document to define p.

Item Essentiality Value	% of System Requisitions
1	29
2	15
3	33
4	23
Total	100

The computation and result of the equation to determine overall ADD is shown below:

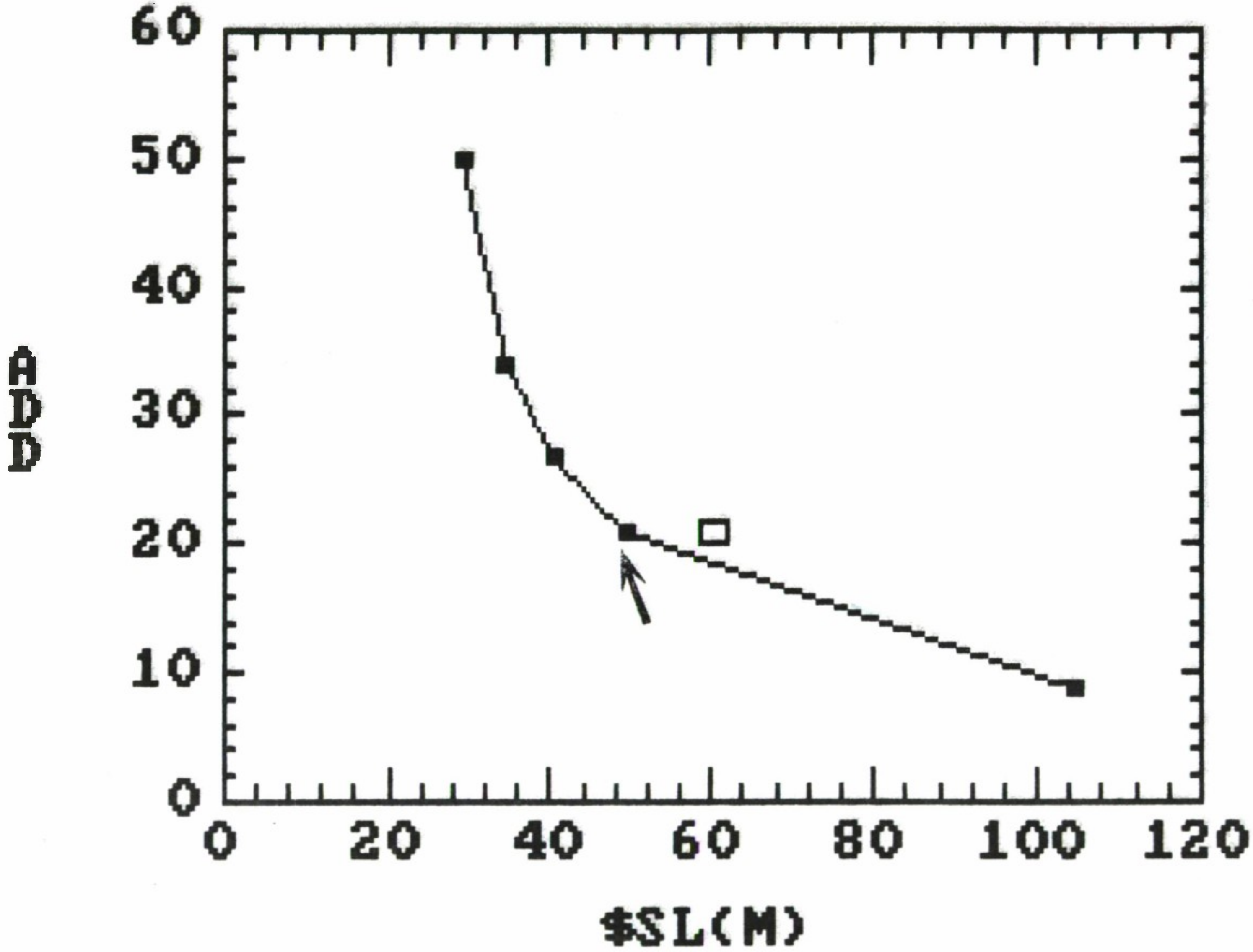
$$ADD = (33)(.29) + (28)(.15) + (23)(.33) + (22)(.23)$$

$$ADD = 26$$

APPENDIX D: COST VERSUS EFFECTIVENESS GRAPHS

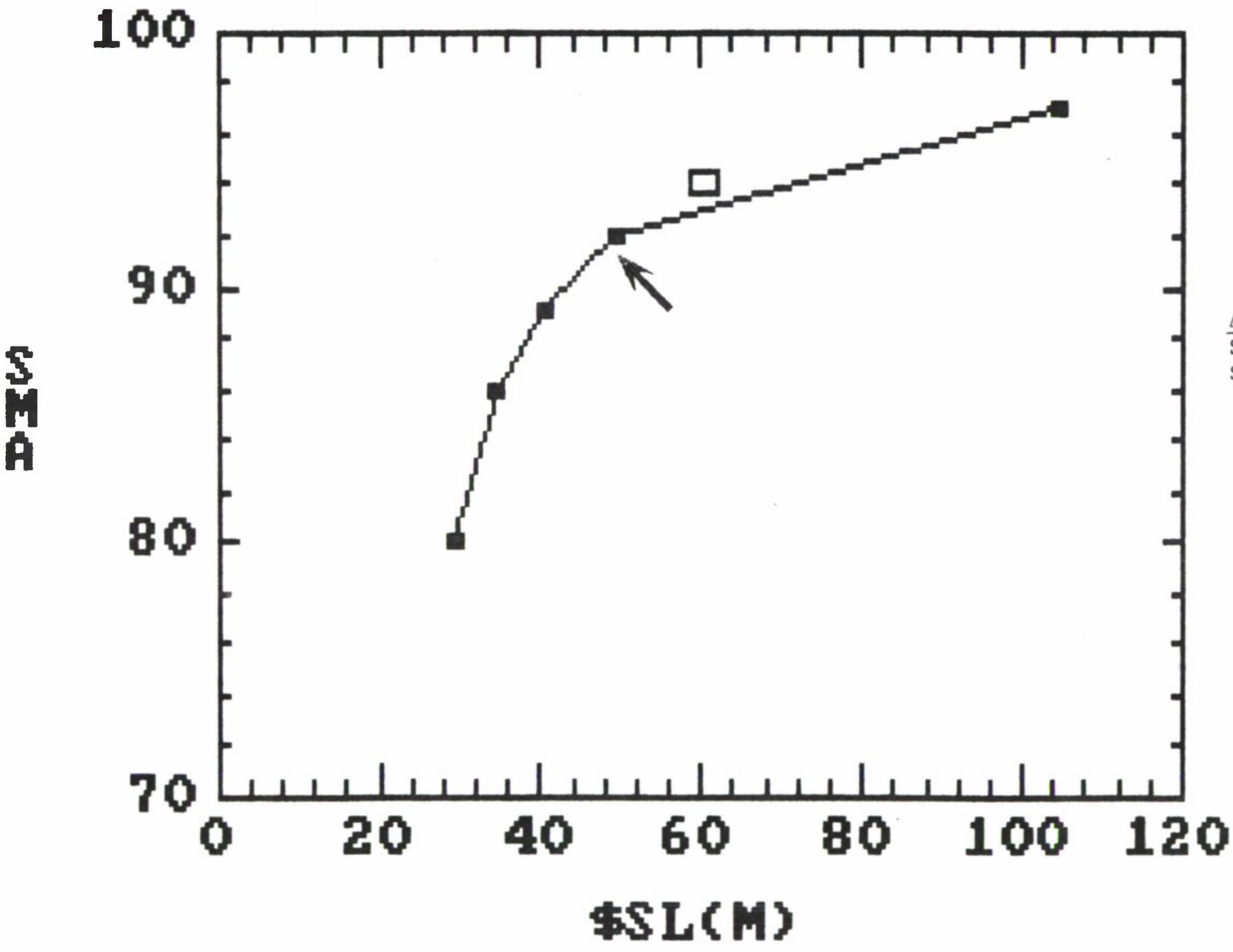
These graphs plot Computation and Research Evaluation System (CARES) Average Days Delay (ADD) and Supply Material Availability (SMA) versus Safety Level ($SL) for each Item Essentiality value within a two digit Cognizance Symbol (Cog). The graphs are presented in the same order as results were presented in the tables of this document; i.e., 1H1, 1H2, ... 7G4. The ADD graph comes before the SMA graph for each Cog. An arrow ( ) identifies the recommended cost and effectiveness values, and a square ( ) represents the current Execution cost and effectiveness values. The difference from the Execution results to the recommended values (Δ X to R) is also shown on the graphs. The recommended values identified by the arrow and the differences between the Execution and recommended results are identical to those displayed in TABLE XI of this document.

1H1



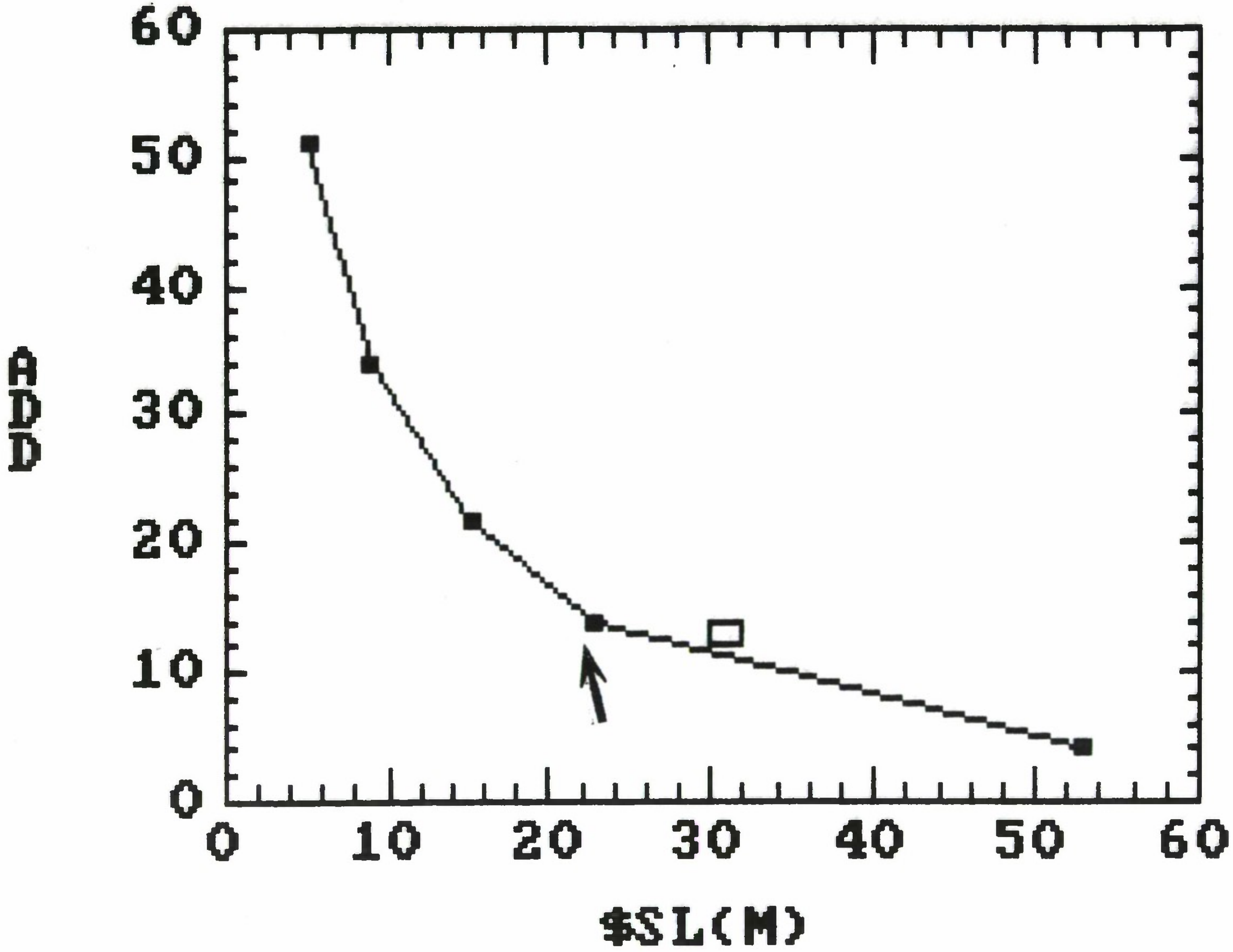
Δ X to R	
ADD	0
$SL	-11.1M

1H1

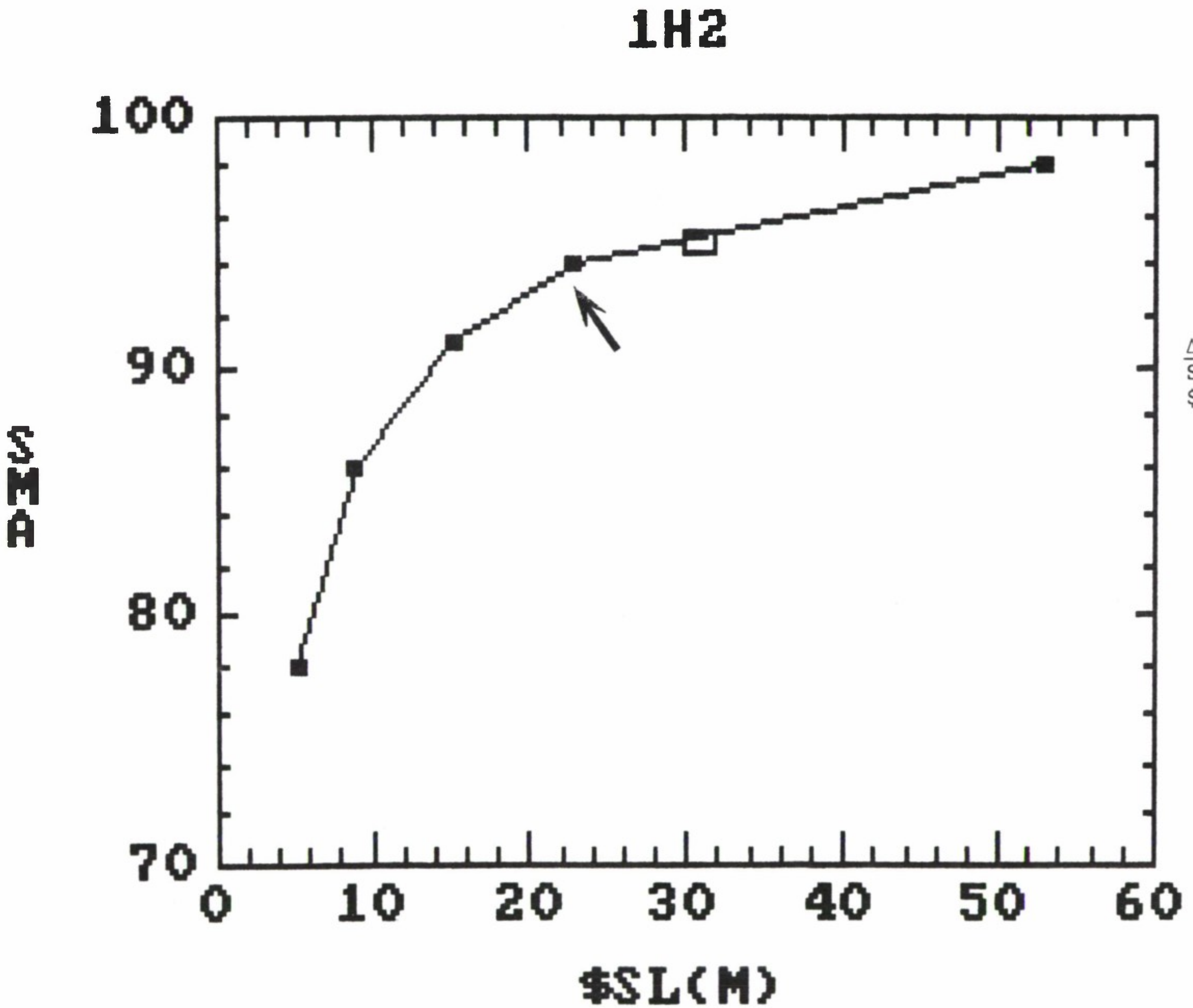


Δ X to R	
SMA	-2
$SL	-11.1M

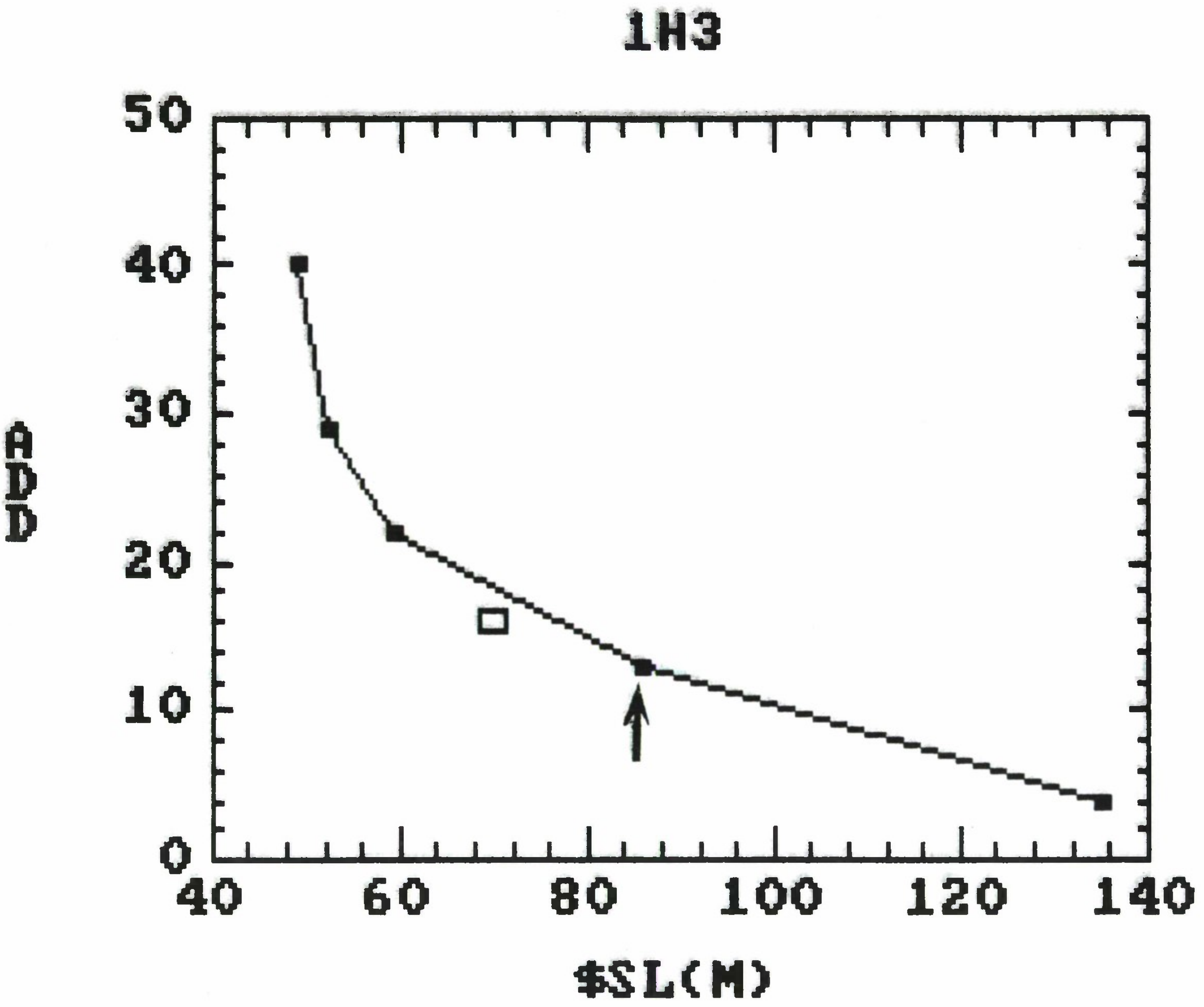
1H2



Δ X to R	
ADD	+1
$SL	-8.0M

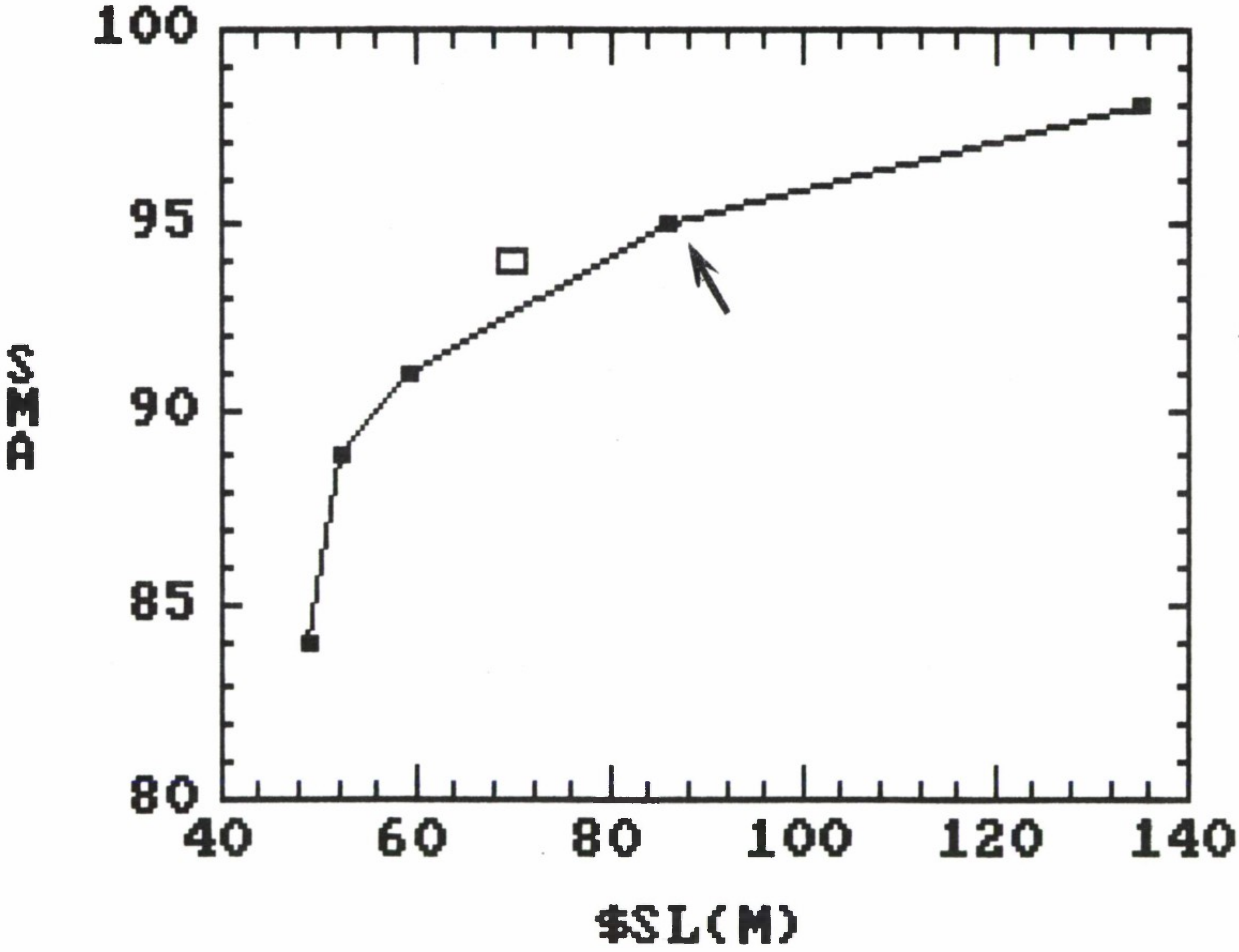


Δ X to R	
SMA	-1
$SL	-8.0M

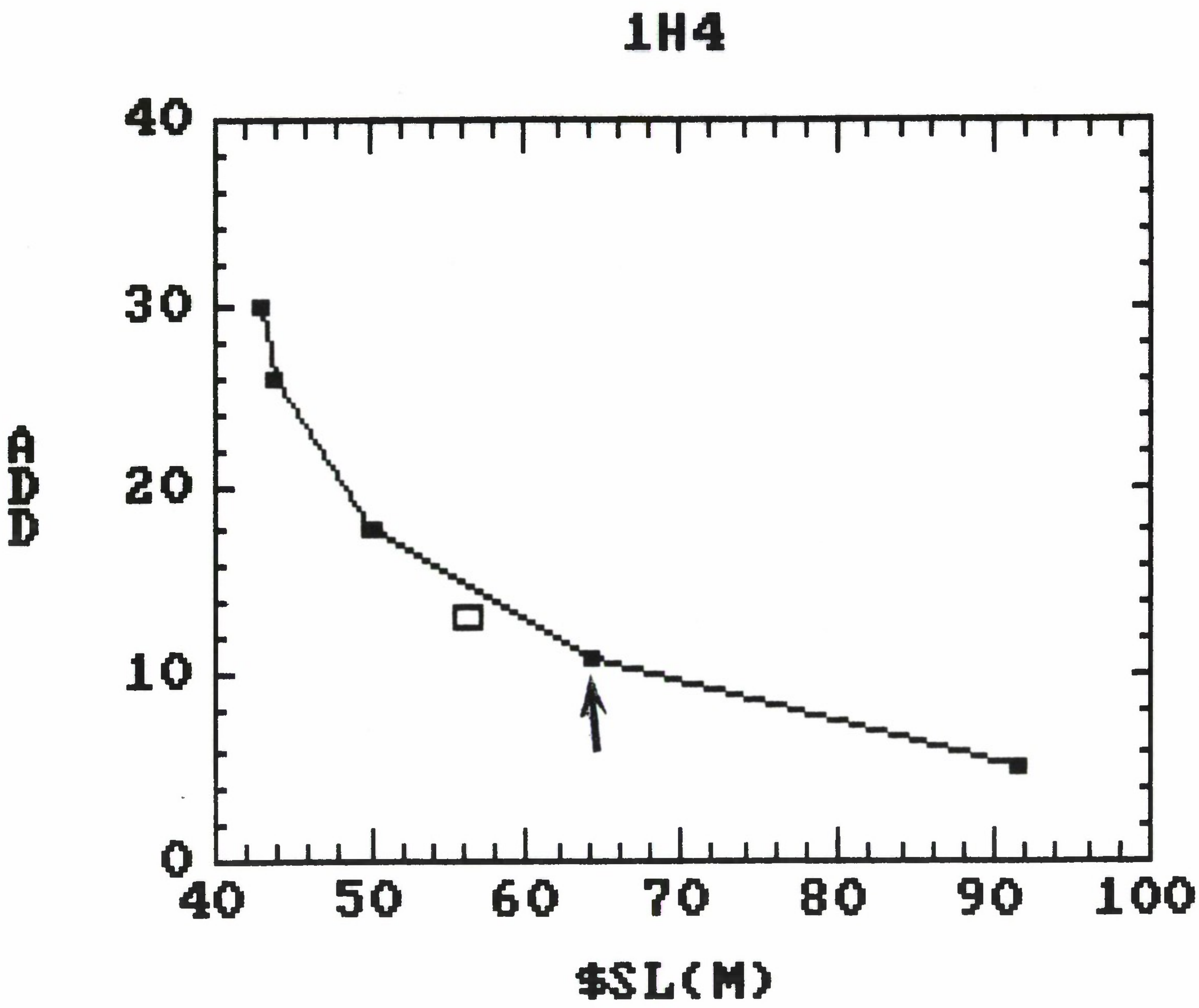


Δ X to R	
ADD	-3
$SL	+16.2M

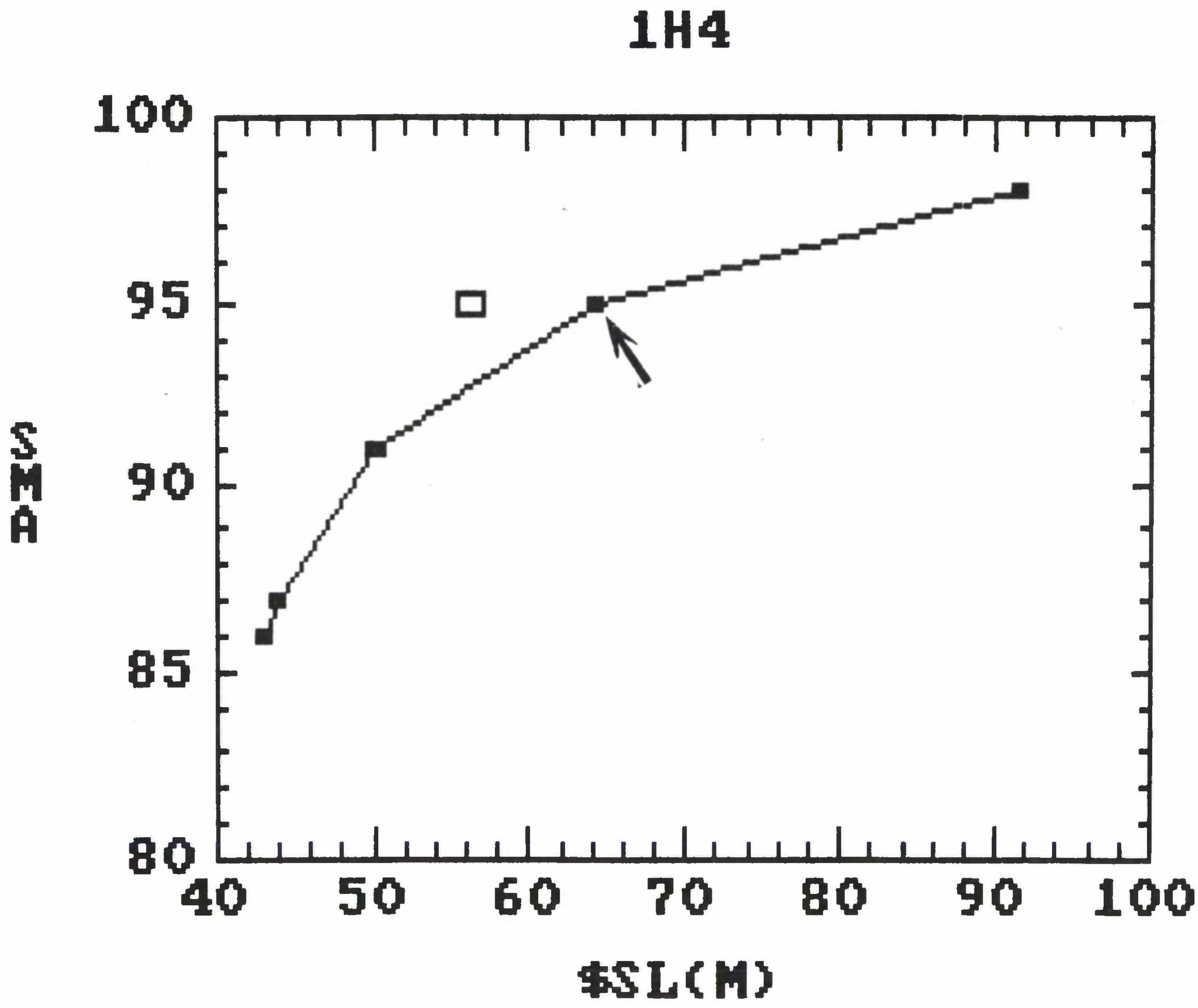
1H3



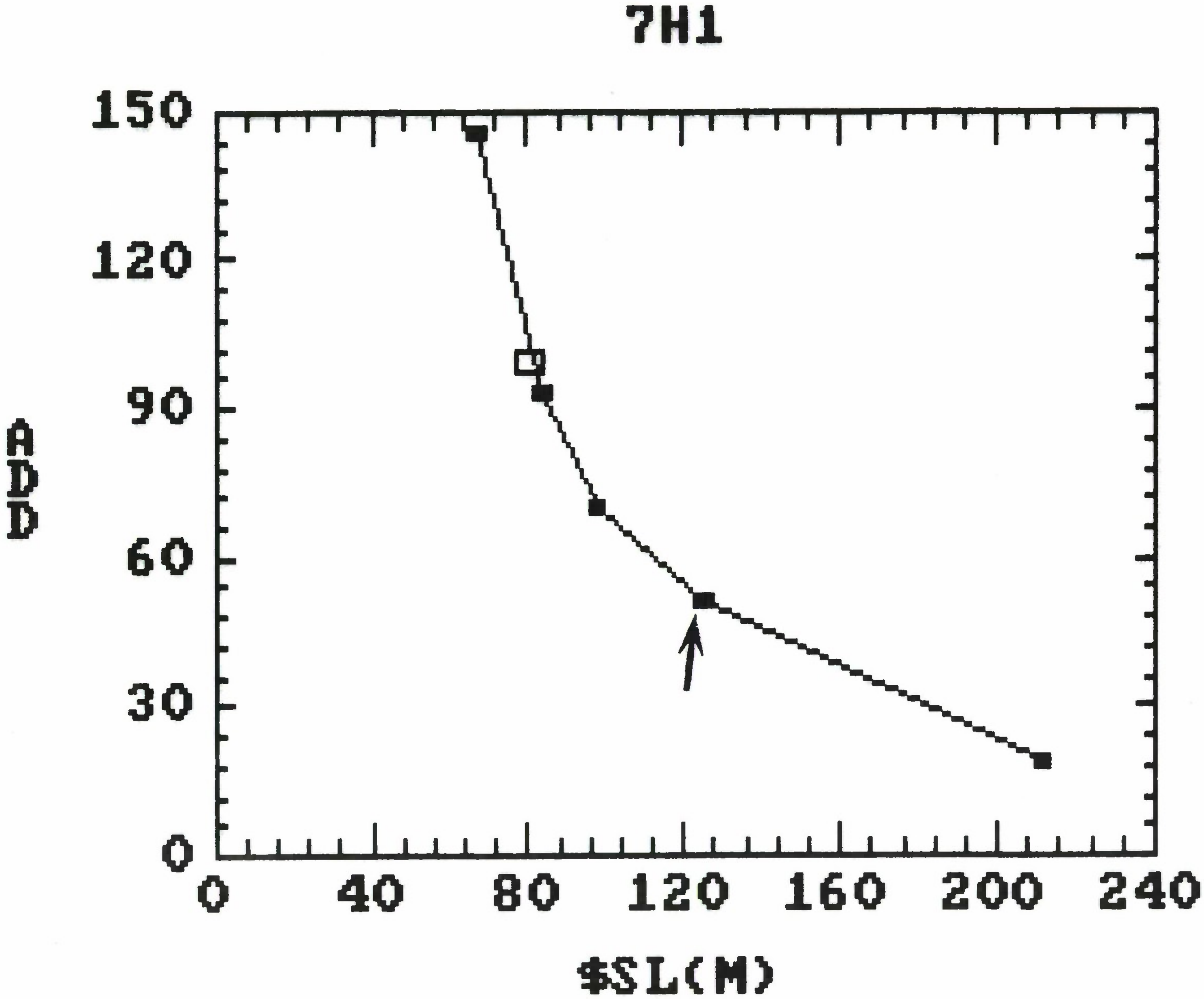
Δ X to R	
SMA	+1
$SL	+16.2M



Δ X to R	
ADD	-2
$SL	+7.9M

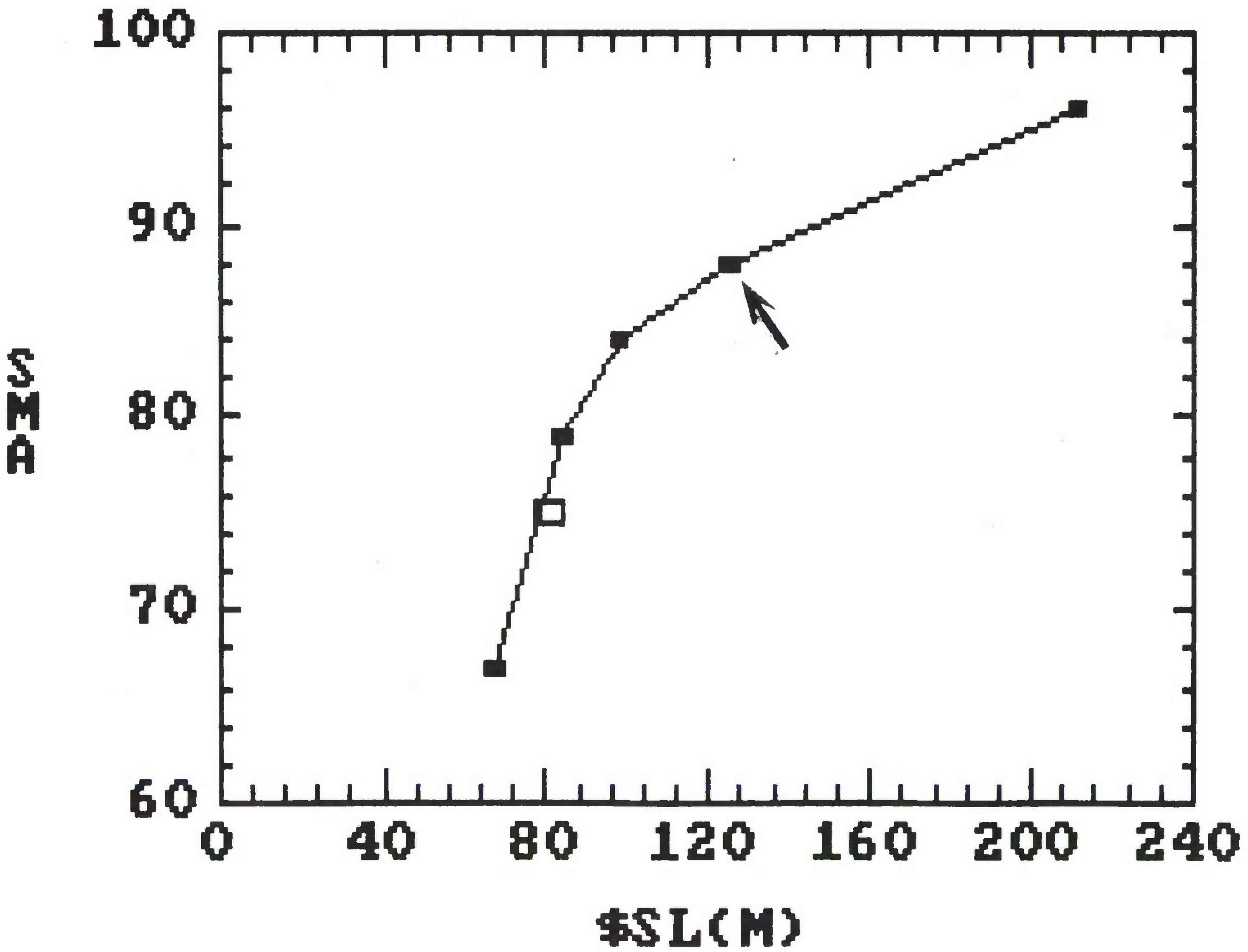


Δ X to R	
SMA	0
$SL	+7.9M



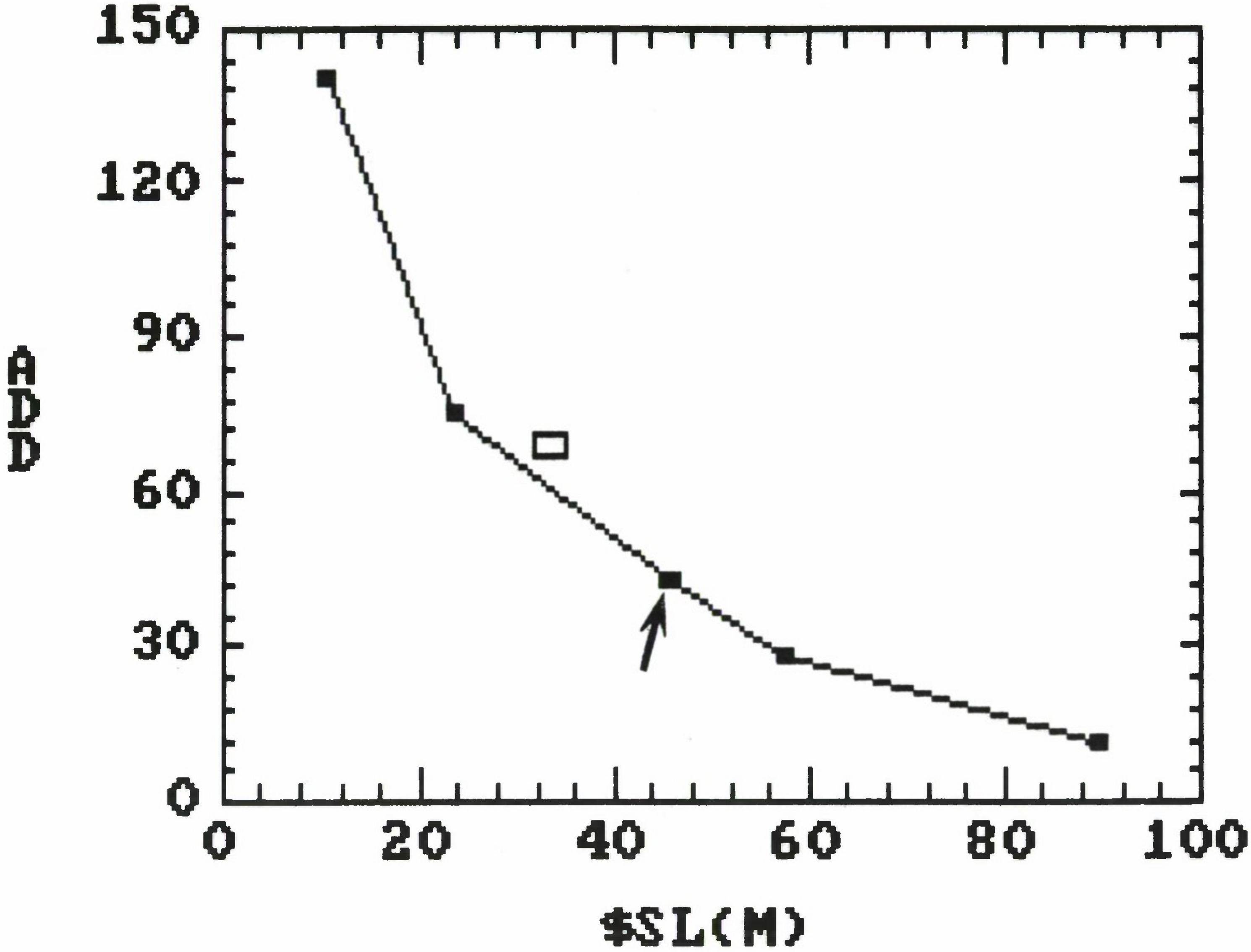
Δ X to R	
ADD	-49
$SL	+44.7M

7H1

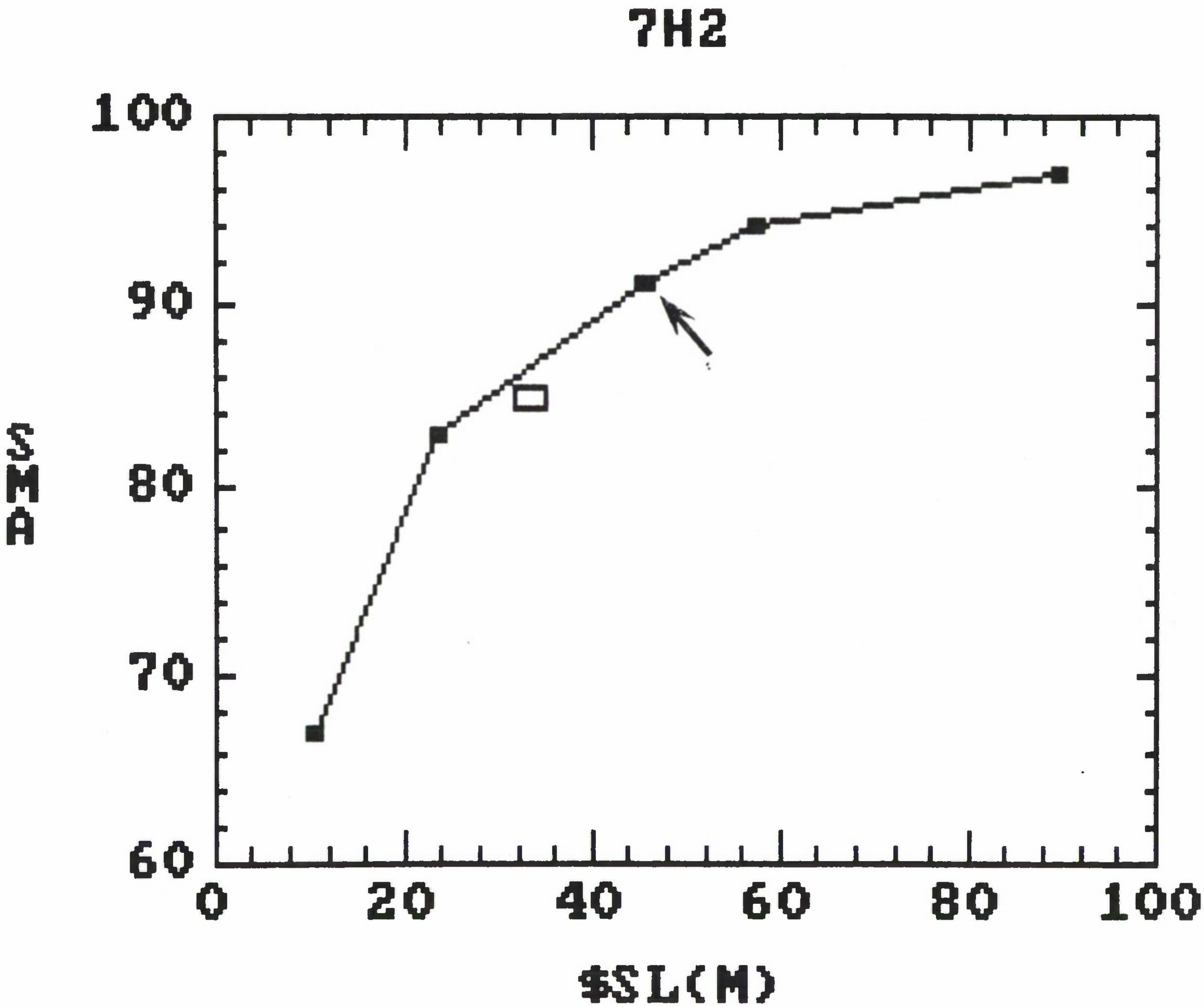


Δ X to R	
SMA	+13
$SL	+44.7M

7H2

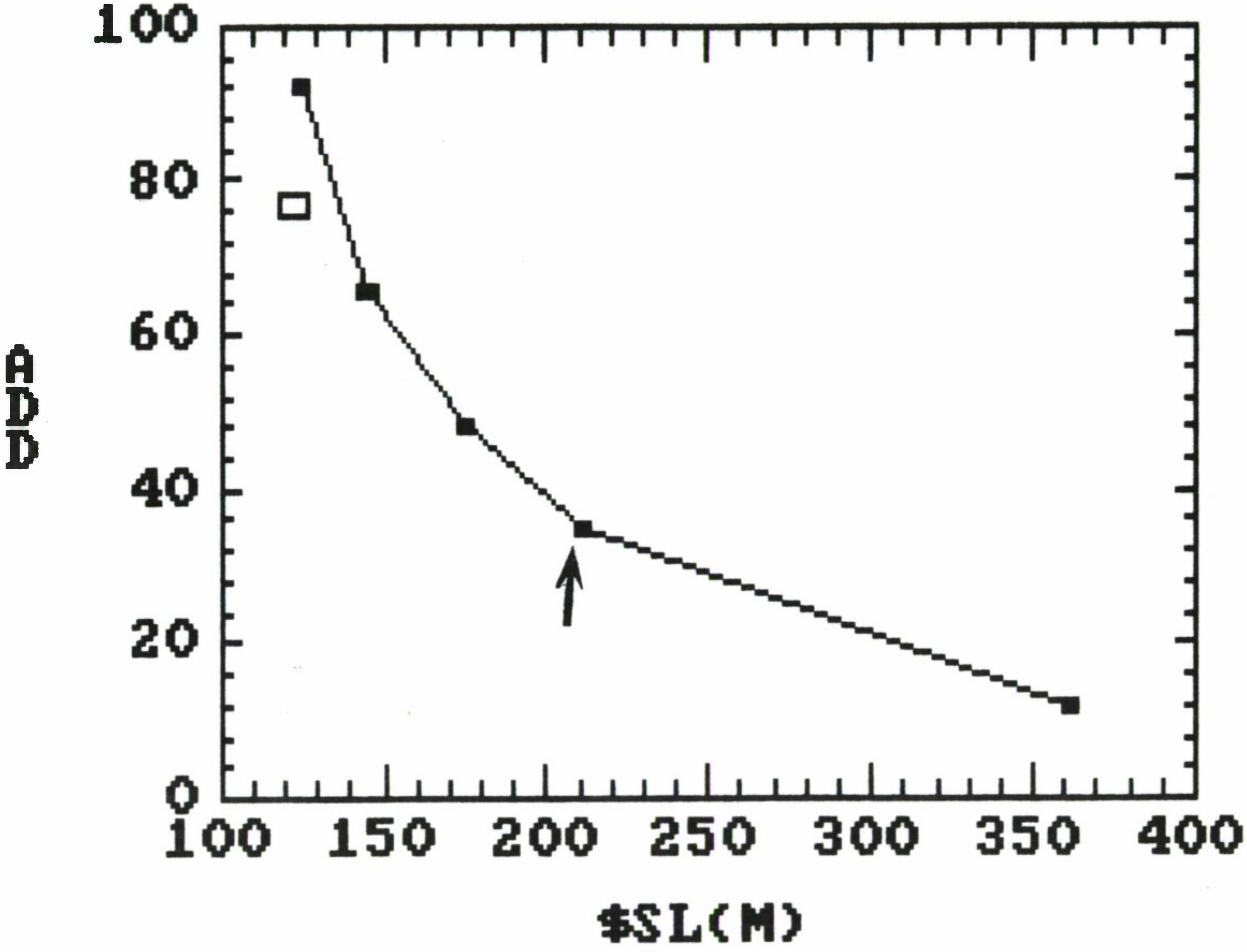


Δ X to R	
ADD	-26
$SL	+12.4M

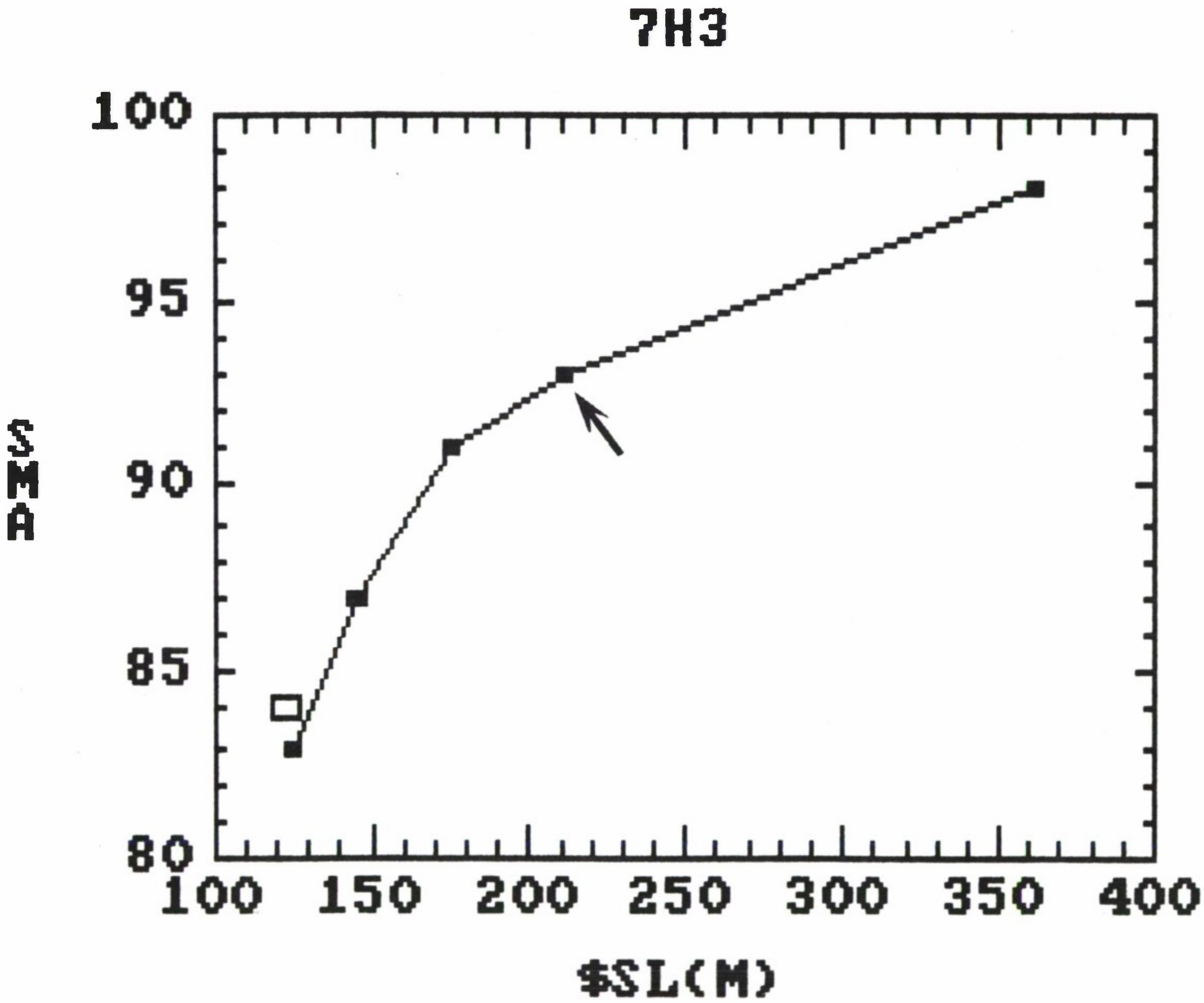


Δ X to R	
SMA	+6
$SL	+12.4M

7H3

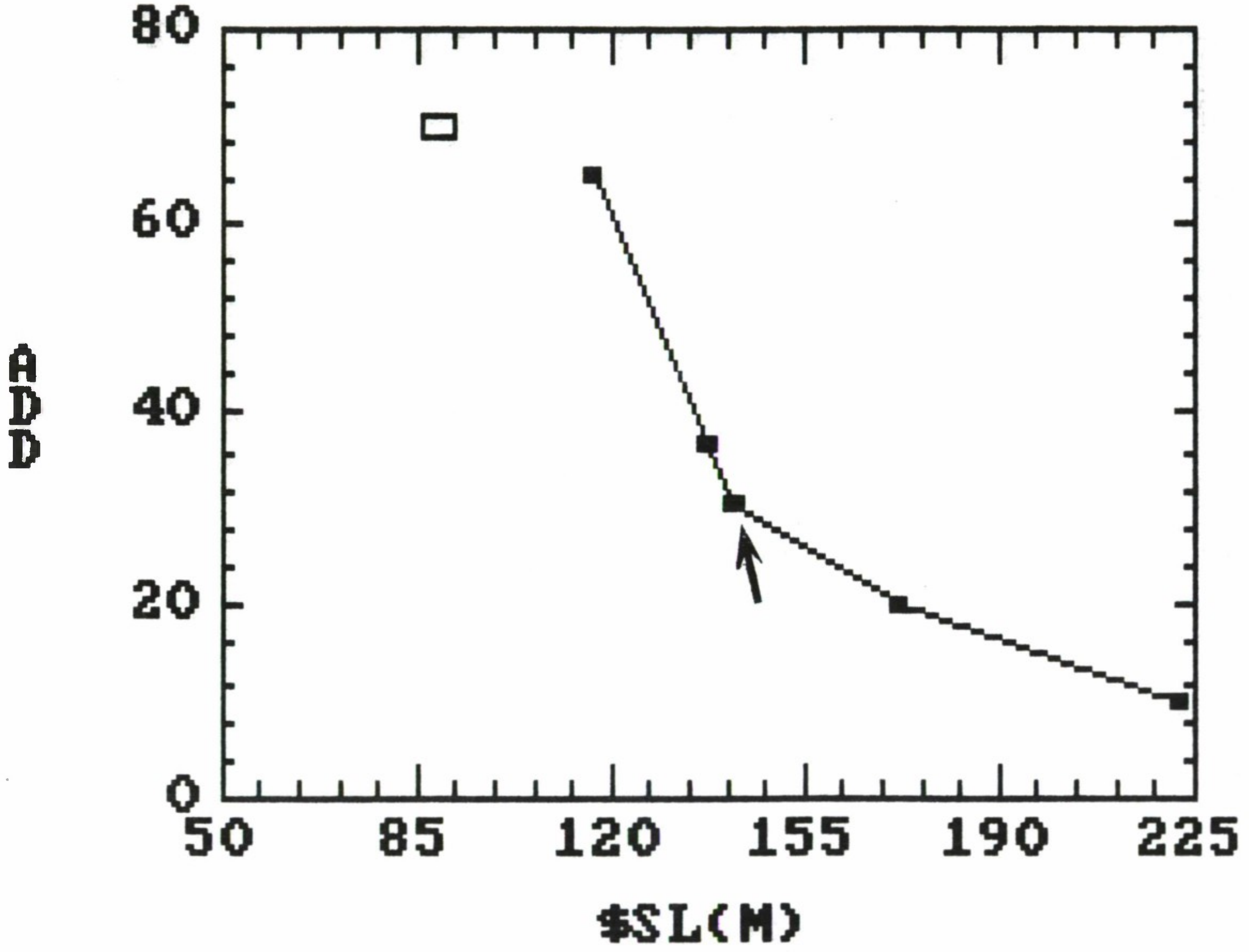


Δ X to R	
ADD	-42
$SL	+88.9M

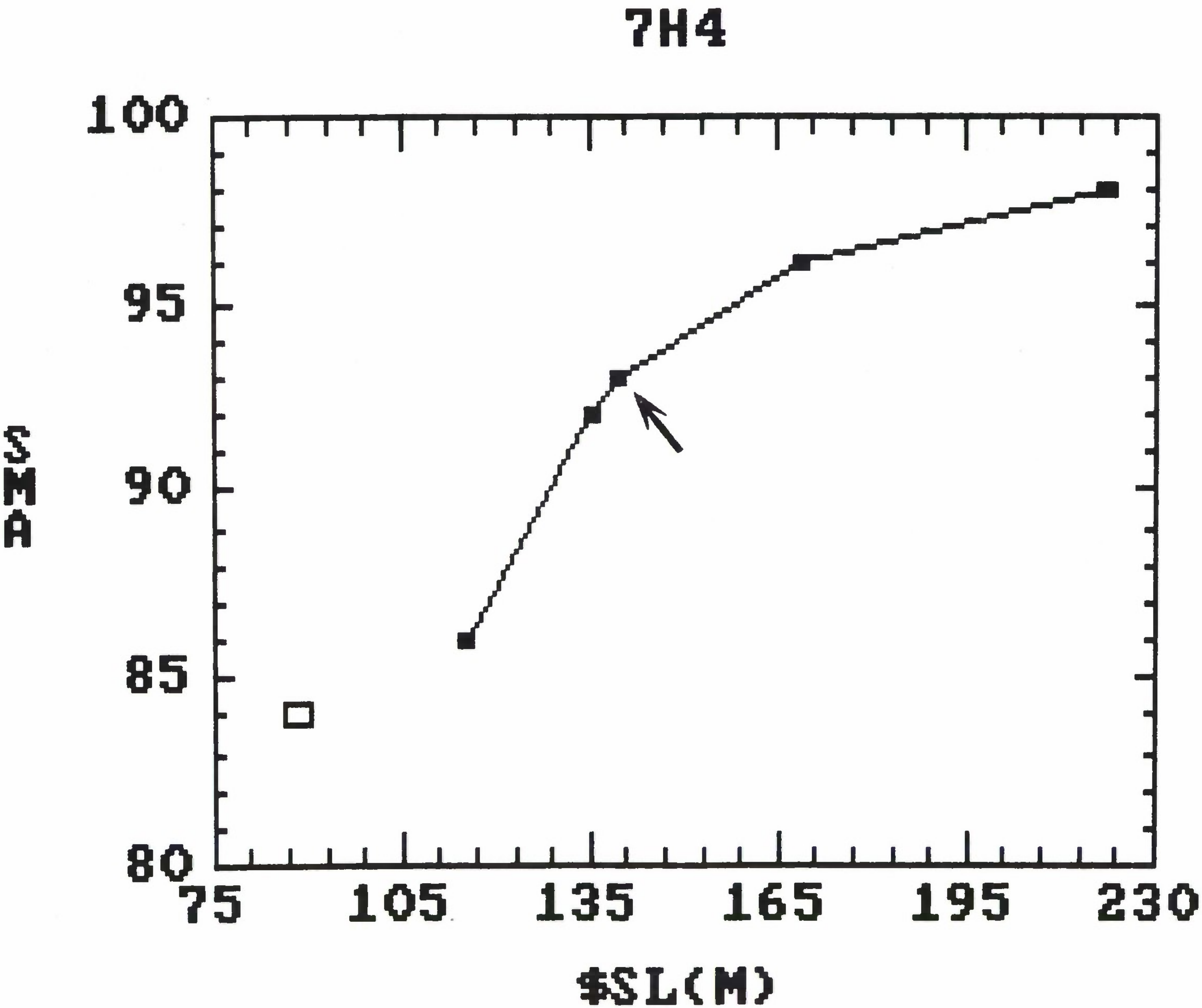


Δ X to R	
SMA	+9
$SL	+88.9M

7H4

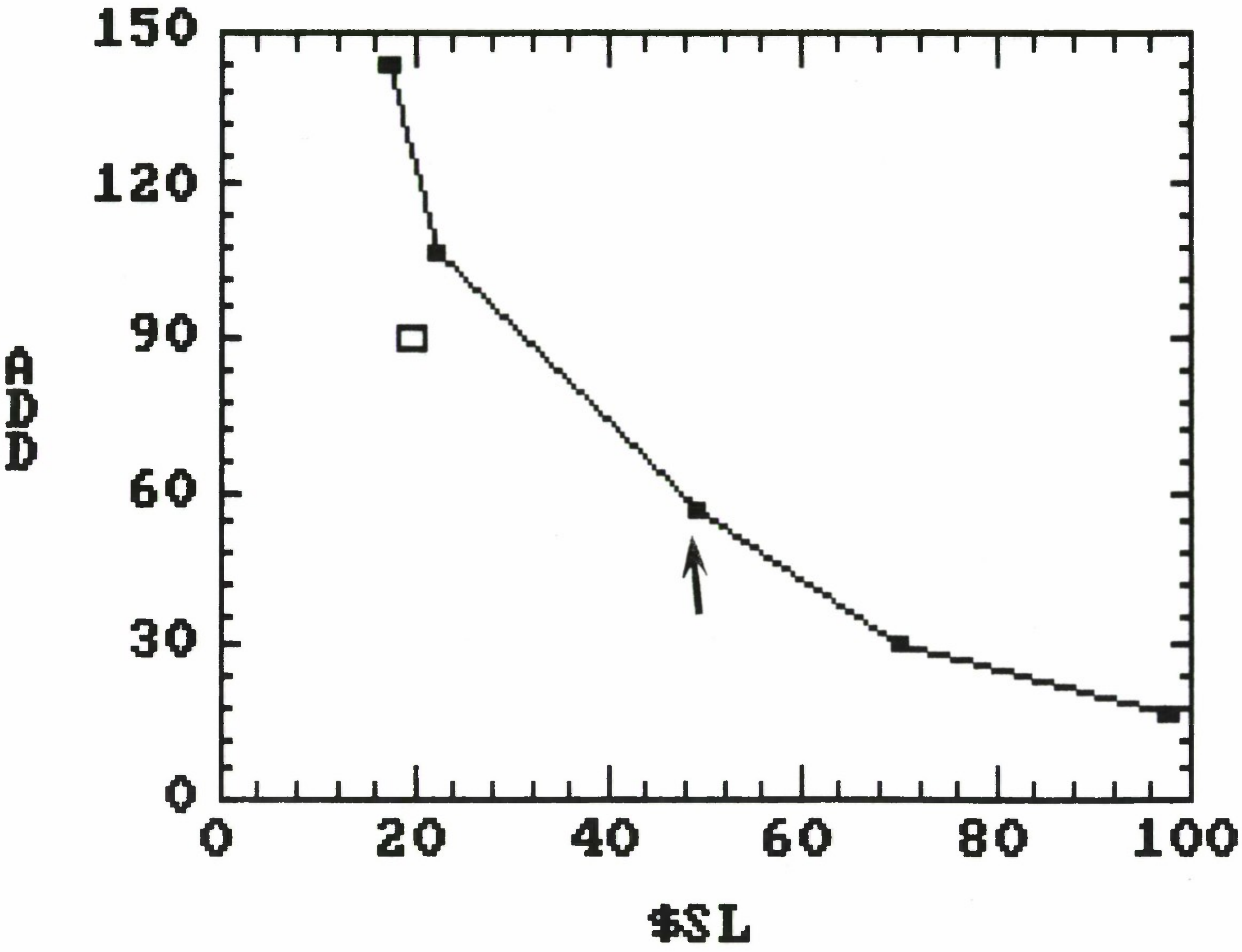


Δ X to R	
ADD	-39
$SL	+53.4M



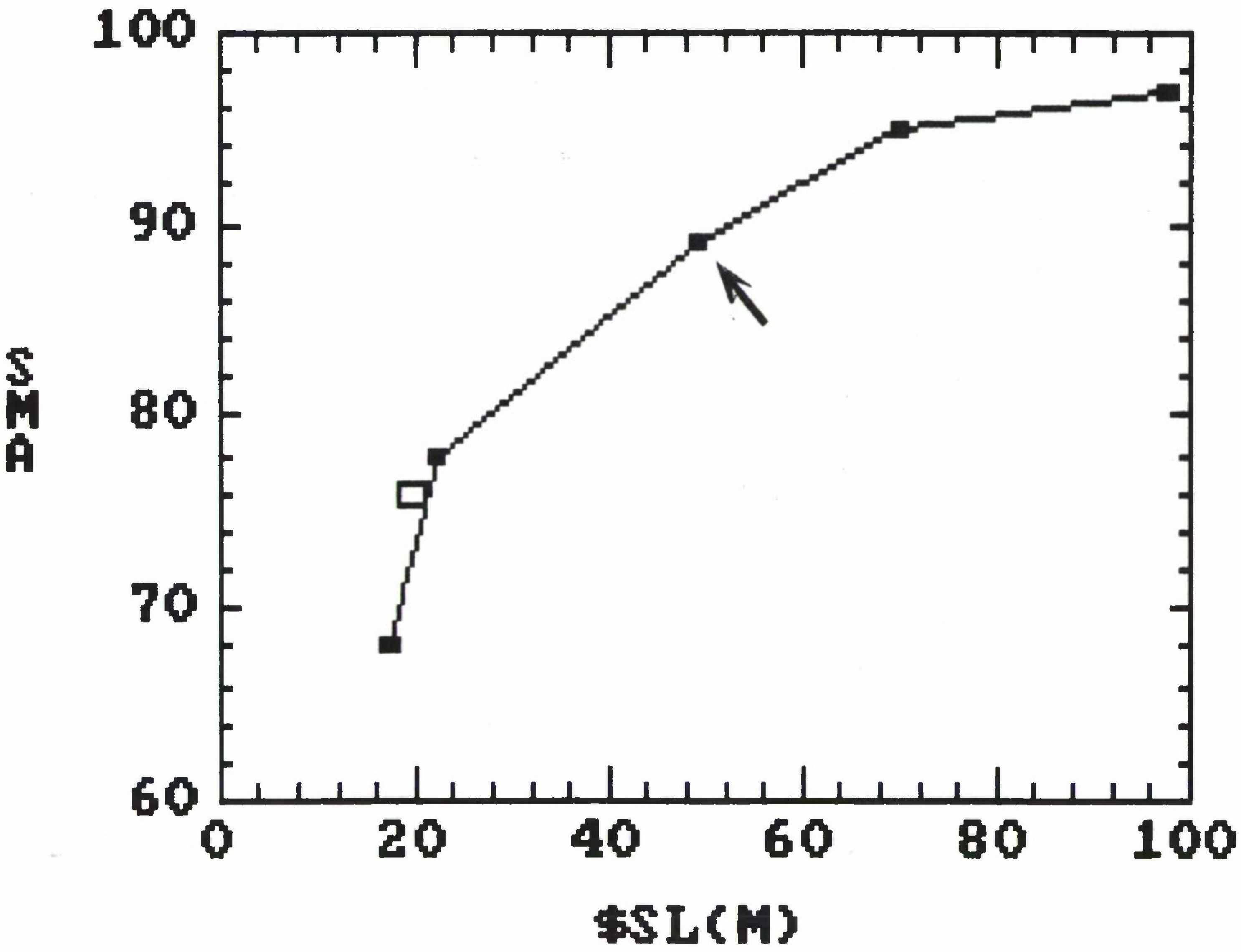
Δ X to R	
SMA	+9
$SL	+53.4M

7G1



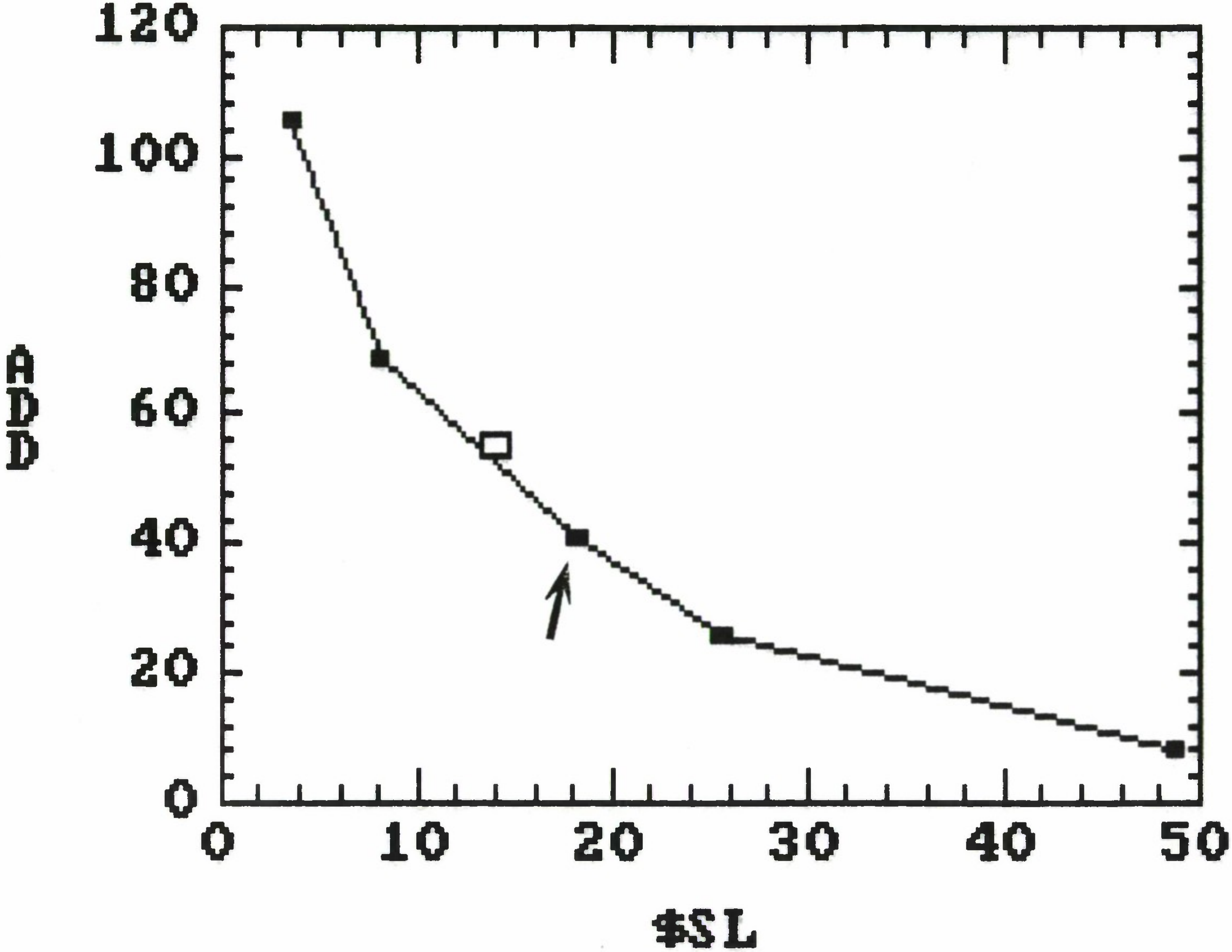
Δ X to R	
ADD	-33
$SL	+29.6M

7G1



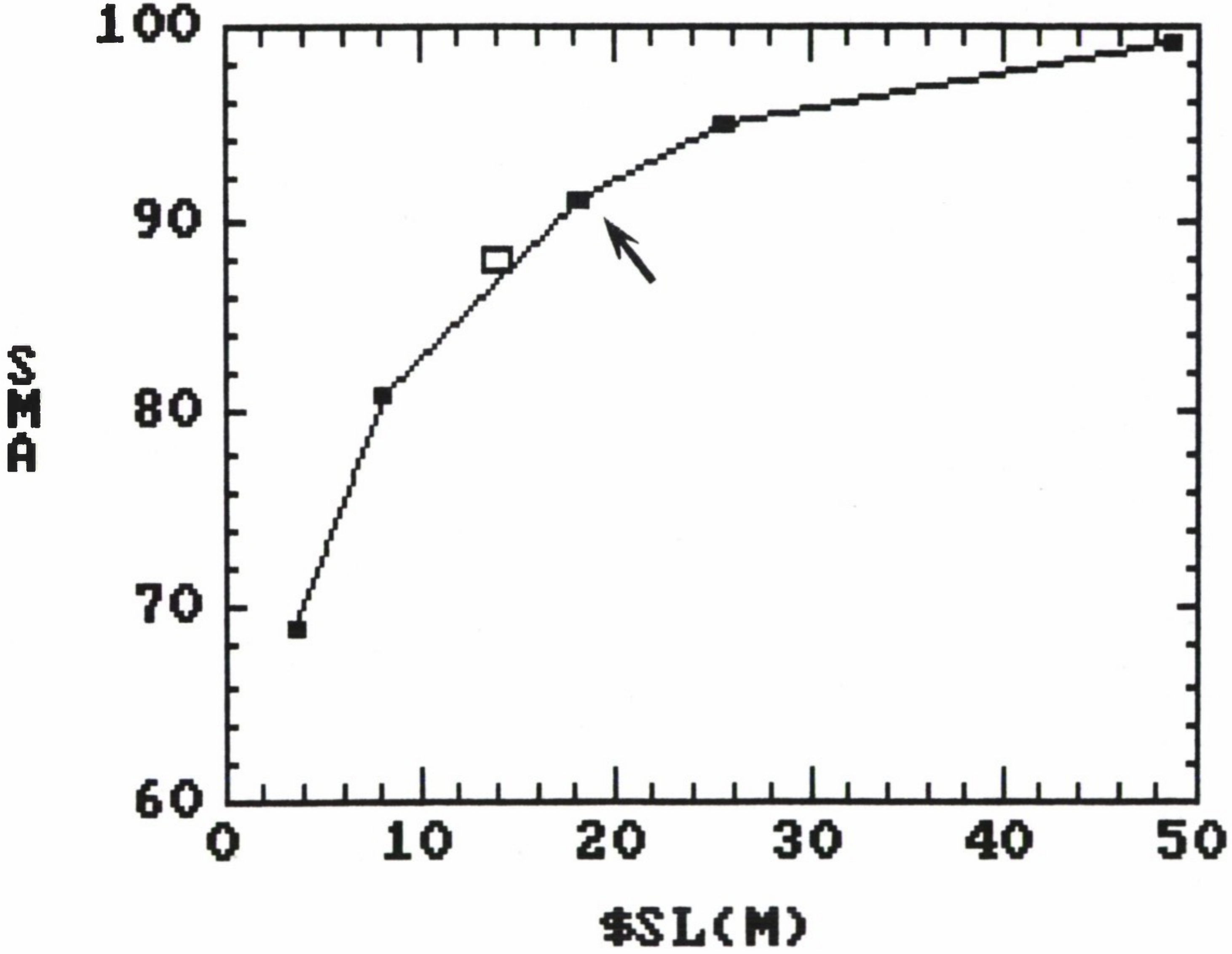
Δ X to R	
SMA	+13
$SL	+29.6M

7G2



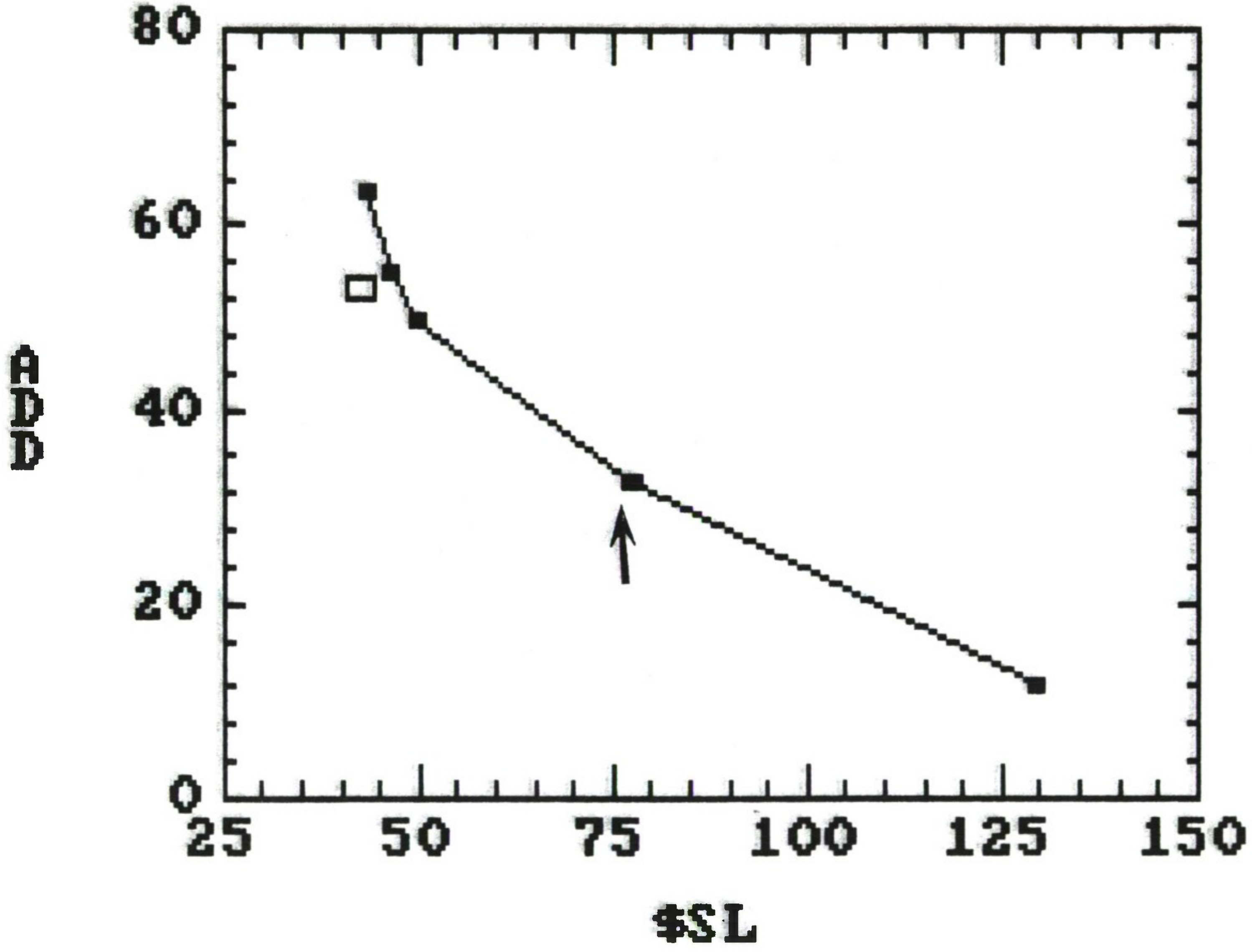
Δ X to R	
ADD	-14
$SL	+4.2M

7G2

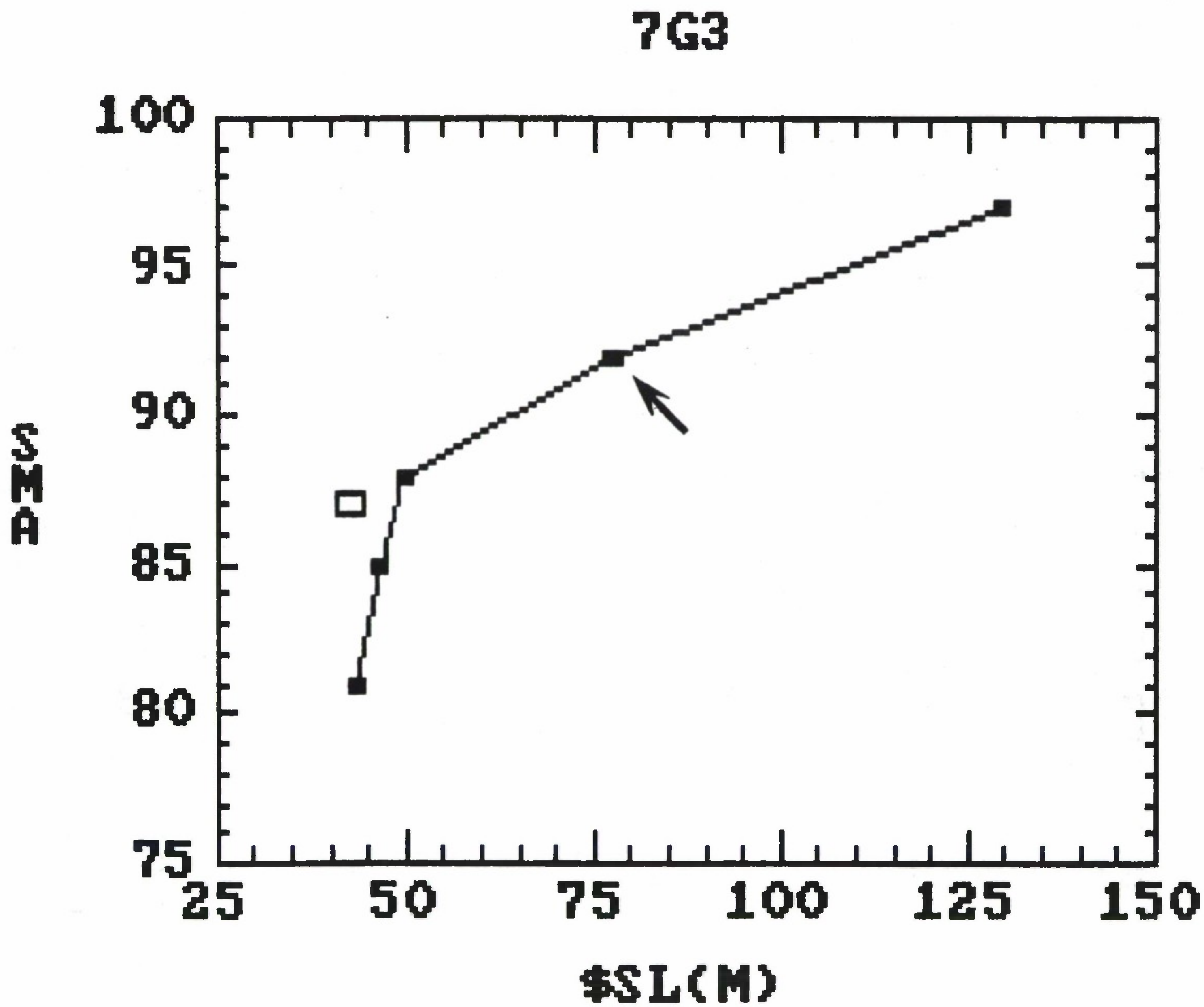


Δ X to R	
SMA	+3
$SL	+4.2M

7G3

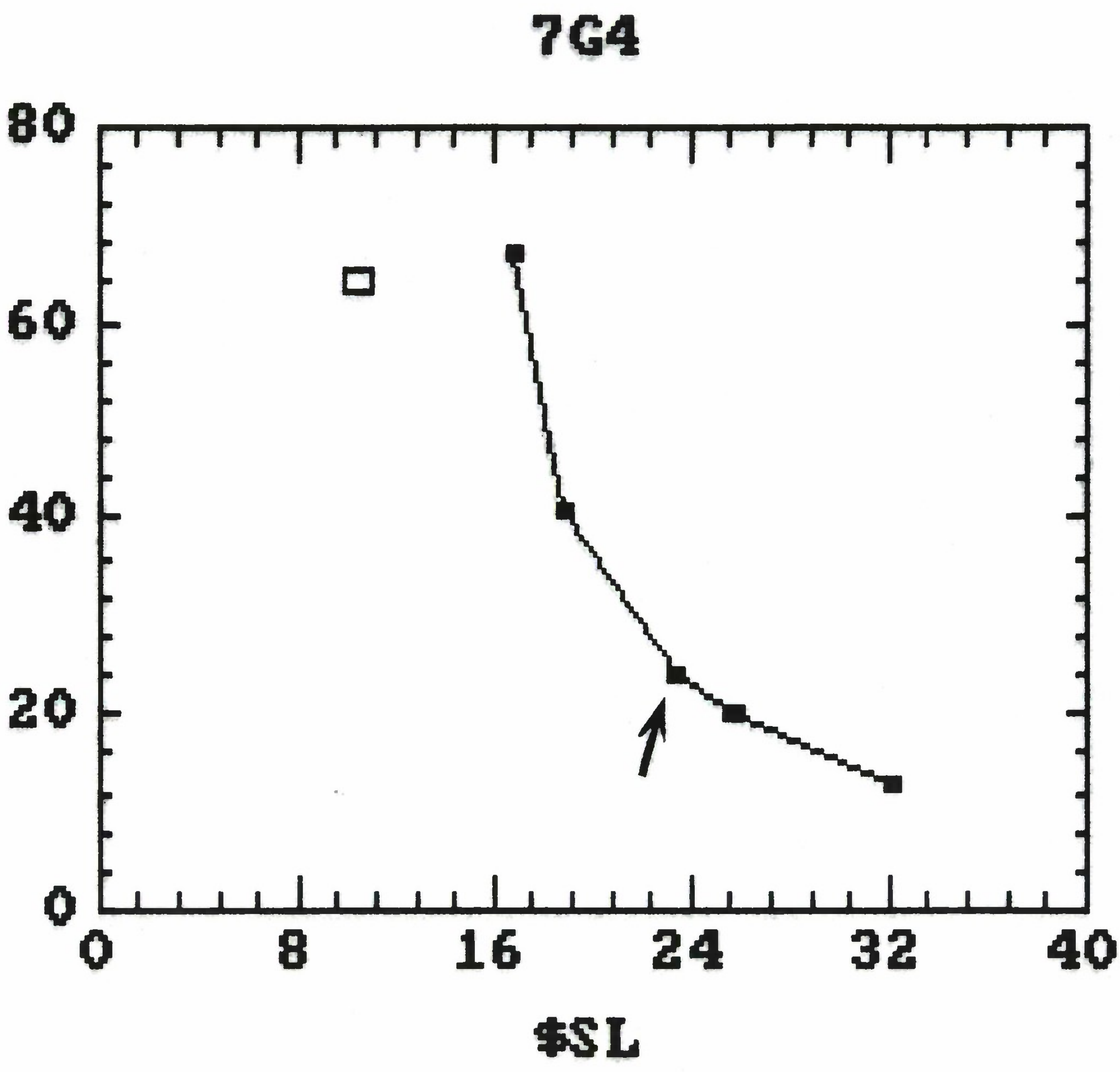


Δ X to R	
ADD	-20
$SL	+35.0M

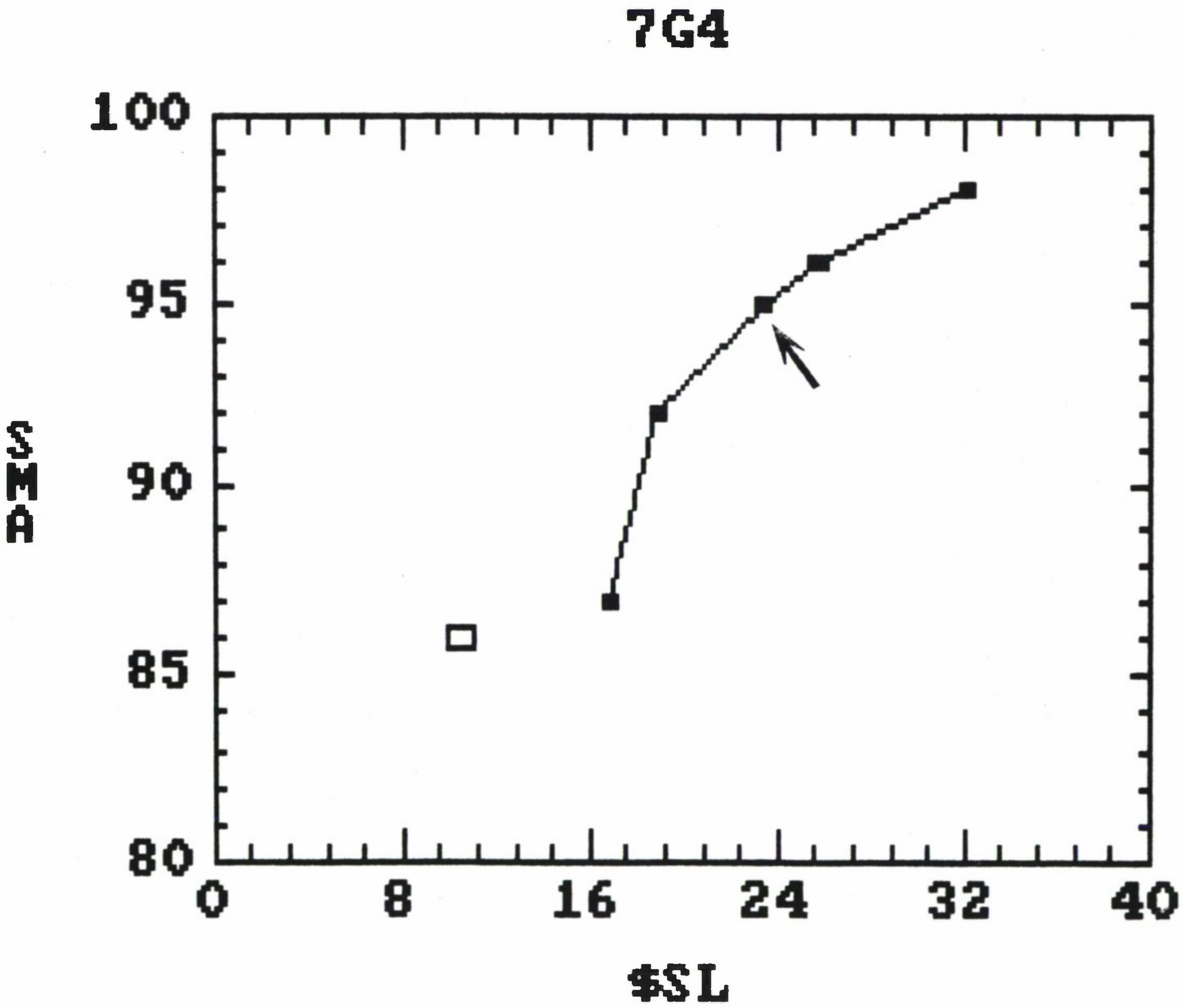


Δ X to R

SMA	+5
$SL	+35.0M



Δ X to R	
ADD	-40
$SL	+13.0M



Δ X to R	
SMA	+9
$SL	+13.0M

APPENDIX E: SHORTAGE COSTS (λE)

The shortage costs required to achieve the recommendations are shown below. These values were used for September 1984 data and will vary as the items change. The values shown below represent the product of shortage cost and essentiality parameters from the risk equation. The current risk equation sets essentiality to a constant value of .5. If this parameter remains at .5 for the proposed policy, the λE values shown below will need to be doubled.

Cog	λE
1H1	300
1H2	500
1H3	1,400
1H4	750
7H1	1,400
7H2	1,500
7H3	1,250
7H4	1,000
7G1	1,000
7G2	650
7G3	1,400
7G4	1,750

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Navy Fleet Material Support Office Operations Analysis Division 5450 Carlisle Pike, P. O. Box 2010 Mechanicsburg, PA 17055-0787	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

3. REPORT TITLE

Applying Item Essentiality to Wholesale Levels Setting

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

5. AUTHOR(S) (First name, middle initial, last name)

Jerry L. Zamer

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
MAR 29 1985	30	9

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO. 9322-D37-5078	162
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d.	

10. DISTRIBUTION STATEMENT

Distribution of this document is unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY

13. ABSTRACT

This analysis develops a method of using Item Essentiality values in computing wholesale Safety Levels. Item Essentiality values signify the importance of an item to the Navy Supply System. Item Mission Essentiality Codes (IMECs) and equipment Mission Criticality Codes (MCCs) were used to develop Item Essentiality values. This analysis recommends Supply Material Availability (SMA) and Average Days Delay (ADD) standards for each Item Essentiality value within a two digit Cognizance Symbol (Cog). No group of items received less protection than currently approved. The recommended effectiveness standards considered Item Essentiality, cost, requisition frequency and procurement leadtime.

DD FORM 1 NOV 65 1473 (PAGE 1)

S/N 0101-807-6801

Security Classification

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